

Trade Diversion from Tomato Suspension Agreements

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Abstract: Trade barriers can cause output to be diverted to other countries and into other products. We study the effect of a voluntary price restraint (VPR) on Mexican tomato exports entering the United States. The diversion effects of the VPR are statistically and economically significant – representing over four-fifths of the direct effects of the trade barrier. When the VPR was binding, Mexico exported more tomatoes to Canada, the United States cut back on exports while Canada increased their exports to the United States. The VPR also caused fresh tomatoes in Mexico to be diverted into paste production, which was then exported to the United States.

Keywords: Trade diversion, Voluntary Price Restraint, Suspension Agreement, Tomatoes, NAFTA
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Bilateral trade barriers not only alter trade flows between the named exporter and importer, they can divert trade to third countries, and from raw to processed goods. This trade diversion may largely offset the intended price gains from the trade barrier. We trace the effect of an anti-dumping suspension agreement that resulted in a voluntary price restraint (VPR) on Mexican tomato exports to the United States. We consider the effect of the VPR on trade in fresh tomatoes among the North American Free Trade Agreement (NAFTA) countries, and between fresh and processed tomatoes.

We use a broad definition of trade diversion to include not only imports from third countries induced by the trade barrier, but also increased exports from the affected exporting country to third countries, also referred to as ‘trade deflection’ (Bown and Crowley 2007a). Last, we include the diversion from raw to processed goods, which are subsequently exported.

No previous paper has looked at the trade diversion effects of a VPR and only a few papers have examined the diversion effect of antidumping cases. In a comprehensive study of trade diversion in antidumping (AD) cases, Prusa (1997) uses 7-digit Tariff Schedule of the United States Annotated (TSUSA) data on U.S. antidumping cases and finds that the instigation of the cases caused considerable trade diversion from the named countries (those facing tariffs) to other exporters. He concludes that, over the six years following initiation of an investigation, the resulting trade diversion almost completely mitigated the effect of the trade restriction due to the tariffs.

Krupp and Pollard (1996) find evidence of trade diversion in chemical industry AD cases using monthly import data. Imports from non-named countries rose during the investigation in

slightly fewer than half the cases (9 out of 19), and these imports rose after the conclusion of the case in 11 cases. However the specific effects of AD duties were more difficult to identify. Duties increased imports from non-named countries in only 9 out of the 17 cases that had AD duties imposed. Both Prusa and Krupp and Pollard find that there were reductions in imports from named countries even if the case was terminated. In a 1995 investigation, the USITC considers the effect of AD cases from 1980 to 1993 on trade diversion, and found that during the latter part of their sample, imports from non-named countries grew 24 percent (USITC 1995).

Konings et al. (2001) examine trade diversion caused by European Union AD cases. They observe some evidence of import diversion, but few of these effects are statistically significant. They find smaller trade diversions than those reported by Prusa for the United States. Konings et al. separate the effect of AD duties and of “price-undertakings” where the European Commission imposes a minimum price on the imported goods named in the AD case (which is similar to a VPR). They find no statistically significant effect for non-named countries with price undertakings. Like Prusa and Krupp and Pollard, Vandebussche et al. find that terminations of the AD cases due to negative findings also generate a further reduction in imports from the named country. In a recent paper on trade diversion, Gulati and Malhotra (2006) find that those provinces not affected by CVD duties increased their lumber exports to the United States during the Canada-U.S. lumber dispute.¹

All five of the panel studies use multiple cases to examine the effect of a single shock—an AD case—on trade diversion. Because an AD case can affect trade before the case is initiated, during the investigation, and even after a case is withdrawn, it is difficult identify the specific

¹ More recently, a number of authors find administered trade protection and safeguards cause trade deflection to third importers (Bown and Crowley, 2007a and b; Durling and Prusa, 2006)

effect of an AD case on trade diversion. For example, trade may be affected before the initiation of an AD case because of anticipation of quantitative restrictions (Anderson 1992, 1993; Blonigen and Ohno 1999), the threat of AD duties (Fischer 1992, Reitzes 1993, and Prusa 1994), or the investigation effect (Staiger and Wolak 1994, Prusa 2001), as well as any resulting duties imposed.

To isolate the effect of the trade barrier itself, we estimate the diversion effects of a suspension agreement that binds in some periods and not in others. Our study differs from the existing literature in three ways. First, we study the effect of a VPR, which allows us to better identify the diversion effects as we can compare trade flows when the price restraint is binding to when it is not. The on-and-off nature of this barrier allows us to disentangle how much producers decreased exports overall after the suspension agreement, and how much they and others shipped elsewhere when the trade barrier was binding. Because we have monthly data on a perishable product, the observed trade diversion between the countries is relatively unlikely to reflect inter-temporal diversion and storage.

Second, whereas these previous papers measured the effects of a trade barrier on only imports from third countries, we look at the effects on both imports and exports because the countries that we study engage in two-way trade. Third, while the earlier papers concentrated on trade diversion only between countries named in the AD case and all other countries collectively, we look at diversions to a third major trading partner, diversion to the rest of the world, and diversion into processed products.

We find that tomato VPR trade diversions decreases fresh tomato exports from Mexico by almost half reducing the potential domestic price increase from 4.0 to 2.1 percent. The Canadian greenhouse tomato industry benefits from the border measure, increasing its exports to

the United States by 12 percent. The other beneficiaries are the Mexican processed tomato sector, which use over 50 percent of the tomatoes turned back at the Mexican-U.S. border, and then ship the tomato paste to the United States. When we add in the processed product, 85 percent of the Mexican tomatoes turned back by the trade barrier make their way into the United States through trade diversion.

We start by describing tomato trade under the NAFTA and giving a brief history of the trade dispute. Next, we briefly review the theory of a price floor. Then, we discuss our estimation technique, the data we use, and our results.

Background

Tomatoes are an important product in all three NAFTA countries. The United States is the second largest producer of tomatoes in the world after China. Florida produces 43 percent of all U.S. domestic fresh tomatoes, and California produces 31 percent of all fresh and 95 percent of all U.S. processing tomatoes. In 2007, U.S. fresh-market tomatoes were forecast to have a farm value of over \$1.3 billion and an estimated retail value of over \$6.2 billion. Processed tomatoes had a farm value of slightly under \$900 million (USDA-ERS 2007).

Tomatoes are Mexico's second highest value agricultural export, bringing in about half a billion dollars per year. Tomatoes for export are grown primarily in Sinaloa in the winter and Baja in the summer. Relatively few Mexican growers produce tomatoes for export to the United States, and they use more capital-intensive production technology than do firms that produce for the domestic market (Calvin and Barrios, 1998).

Canada produces by far the fewest tomatoes of the three countries. Although tomatoes represent a small portion of Canada's agricultural production, tomatoes make up the largest value of Canadian fresh vegetable exports, and that value rose by more than an order of magnitude

from C\$24.5 million in 1995 to C\$327 million in 2003 (Statistics Canada, 2005). Most of this increase in value is due to the growth in Canada's greenhouse tomato industry, which has increased 13-fold in value over in the last 20 years (Statistics Canada, 2007).

Table 1 shows the three-way tomato trade between the NAFTA countries (note: a "tonne" is a metric ton). Each country exports to and imports from each of the other two countries. The scale of this trade has increased since NAFTA went into effect in 1994. Mexico accounts for 83 percent of U.S. imports of fresh tomatoes, and Canada is responsible for 9 percent of U.S. imports. The vast majority of all U.S. fresh tomato exports go to Canada (91 percent of 1999 exports), while U.S. exports to Mexico (4 percent) rank a distant second.²

Florida and Mexico historically compete for the U.S. and Canadian winter and early spring markets. Over the past ten years, Mexico has increased its market share of the U.S. winter tomato market from 27 percent to close to 50 percent (Calvin and Barrios 1998). Although some other countries (particularly the Netherlands, Spain, and Israel) export fresh tomatoes to the United States and Canada, their shipments are relatively minor.

All three NAFTA countries trade process tomato goods. The United States became a net exporter of processed tomato products during the 1990s; however, the United States still imports some tomato products, of which 24 percent are from Canada, 24 percent; 22 percent from Chile; and 18 percent from Mexico (USDA-ERS 2007). In the United States and Canada, the tomatoes used for processing and fresh sales are distinct varieties and the two tomato markets are separate. In contrast in Mexico, tomatoes that cannot be sold in fresh markets—about 10 percent of the tomatoes grown—are sold for processing.

² On average, less than 0.1 percent of Canadian tomato exports were sold to any country other than the United States and an average of 3 percent of U.S. exports went to non-NAFTA countries.

Most of the Mexican tomatoes enter the United States at border crossings in Laredo, Texas; Nogales, Arizona; or San Diego, California. The price for most tomatoes is established by contracts with distributors before the tomatoes enter the United States. Other truckloads of tomatoes are sold at the Phoenix market where they are bought by distributors, retailers and shippers, who in turn sell them at regional terminal markets throughout the United States. If the market in Phoenix cannot accept all the tomatoes at the reference price, shippers will often wait for a few days in hopes that the price will rise. Their ability to hold the tomatoes is limited, since tomatoes need to be sold at retail within two to three weeks after shipping. If the tomatoes are nearly ripe and still cannot be sold in the Phoenix market, they are either sent back to Mexico to be turned into paste or are destroyed.

Predictably, these close trade ties in a sensitive agricultural product have led to repeated trade disputes (Bredahl et al 1987). In 1978, Florida producer groups brought an anti-dumping case against Mexican winter vegetable production. The U.S. Department of Commerce did not find evidence of dumping and the case was dropped, but tension between Floridian and Mexican producers continued. On April 1, 1996, various U.S. tomato growers (primarily Florida growers) filed an antidumping petition alleging that their industry was threatened by fresh tomatoes from Mexico imported “at less than fair value” (USITC 1996). The petition was in response to a sharp rise in tomato imports (276 percent) from 1992 to 1996, the bulk of which came from Mexico (93 percent in 1996). U.S. production fell 21 percent over the same period, and the U.S. price dropped from \$0.79 per kg to \$0.63 in 1996.

In May, 1996, the USITC found that tomato imports threatened the domestic industry with material injury, the first step in setting supplemental antidumping tariffs to protect the U.S. industry. On December 6, 1996, the U.S. Department of Commerce and Mexico reached a

“suspension” agreement where Mexico would voluntarily limit its exports and in return, the United States would suspend the anti-dumping case and remove the anti-dumping tariffs. Mexico agreed to set a single reference (floor) price of \$5.17 per 25 lb carton (or 20.68¢ per lb) of tomatoes exported to the United States. For the suspension agreement to hold, producers representing 85 percent of the exports had to agree to be bound by the minimum. In 1998, two separate reference prices were set: one for winter and one for summer production. Until July 2002, summer tomatoes (primarily produced in Baja, Mexico) were covered under one reference price that ran from July 1 to October 22 (\$4.30 per 25-lb box) while winter tomatoes (affecting tomatoes produced in Sinaloa) were covered October 23 to June 30 with a higher floor price (\$5.27 per 25-lb box). In July 2002, the suspension agreement was repealed after a number of Mexican tomato shippers refused to renew their commitment to the reference price agreement. The end of the suspension agreement re-initiated the 1996 anti-dumping case, and the Department of Commerce resumed its investigation. The two countries entered into a new suspension agreement in December 2002, which remains in effect. We analyze the effect of only the initial suspension agreement.

The border measure may have had political spillover effects as well. By making the U.S. market more attractive to Canadian producers, the border measure induced a surge in Canadian exports of mostly greenhouse tomatoes to the United States which may have harmed (or at least incensed) U.S. greenhouse producers who would be most affected by the Canadian imports. Responding to complaints from Texas and Florida producers, the U.S. International Trade Commission concluded in May of 2001 that “significant and increasing imports” of Canadian greenhouse tomatoes were depressing prices in the United States and having “a significant

adverse impact on the domestic industry” which led to AD duties ranging of around 32 percent being levied on Canadian imports (USITC 2002). These duties were repealed in April 2002.

Effect of a Price Floor

To illustrate how a U.S. price floor, or reference price, leads to the diversion of Mexican exports to Canada, we use a simple competitive model. We (correctly) assume that the domestic Mexican price for fresh or processed tomatoes is less than the price shippers can receive for fresh tomatoes in the United States or Canada and that Mexican exports are fixed in the short run at X , which is the length of the horizontal axis in Figure 1. Mexican exports to the United States, X_U , are measured from left to right along the horizontal axis, while Mexican exports to Canada, X_C , are measured from right to left, and $X_C + X_U = X$.³

If the reference price is not binding, the equilibrium, e , is determined by the intersection of the U.S. excess demand curve, ED_U , and the Canadian excess demand curve, ED_C . In this equilibrium, the United States imports X_U^1 , Canada imports $X_C^1 = X - X_U^1$, and the export prices to the two countries are equal: $P_U^1 = P_C^1$.

We now consider what happens if the reference price, \underline{P}_U , binds (exceeds P_U^1). If tomatoes can be shipped to the United States by way of Canada at no additional transaction cost (negotiation costs, shipping costs, quality degradation, and other costs), $\tau = 0$, then the reference price is irrelevant, the equilibrium remains at e , and, while, there are no direct shipments to the United States the total amount of tomatoes imported into the United States (by way of Canada), X_U^1 , remains unchanged.

³ We ignore the possible shift to processing here.

However, transaction costs are a significant portion of the import price of fresh tomatoes. As an example, a 1991 study showed that shipping and customs processing charges, before tariffs, were almost \$1.00 (or 15%) on a 25-lb box of winter tomatoes from Sinaloa, Mexico, worth \$6.53 in the United States (American Farm Bureau Research Foundation 1991).

Suppose that total transactions costs, τ , exceed $\underline{P}_U - P_C^2$ so that it does not pay to send tomatoes from Mexico to Canada and then to the United States. Now, \underline{P}_U is the U.S. price, P_C^2 is the Canadian price, Mexican exports to the United States fall to X_U^2 , and exports to Canada rise to X_C^2 .

Finally, suppose that the transaction cost (including tariffs), τ , lies strictly between 0 and $\underline{P}_U - P_C^2$. We determine the new equilibrium by inserting a τ -long vertical wedge between ED_U and ED_C . The equilibrium exports, X_U^3 and X_C^3 , lie between the two extremes and the U.S. price exceeds the Canadian price by the transaction cost: $P_U^3 = P_C^3 + \tau$.⁴

In a more general model with trade between all three countries, the VPR could also affect trade between the United States to Canada. Although we cannot unambiguously sign the effects of trade between all the pairs of these three countries, presumably establishing a reference price, which artificially raises the price in the United States, increases sales of domestic tomatoes in the United States and reduces exports of U.S. tomatoes to Canada. If transaction costs are not prohibitive, Canada could import tomatoes from Mexico and increase exports to the United States. Moreover in an even more general model, the VPR could cause some fresh Mexican

⁴ The model is substantially more complex if the various actors are price setters (e.g., Thueringer and Weiss 2001 finds firms use mixed strategies); however, our basic conclusions are not changed.

tomatoes to be diverted to the processing sector. This paper formally examines how the VPR affects trade flows.

Empirical Model

We start by specifying a structural model and then derive a reduced-form empirical model based on the structural model. Suppose initially that there is only one-way trade between Mexico and the United States. Let the inverse demand function for Mexican tomatoes in the United States be $P = D_U(X_U, V_U)$, where X_U is the quantity of Mexican tomatoes in the U.S market, and V_U is a vector of exogenous variables that shift demand. The inverse supply function of Mexican tomatoes in the United States is $P = S(X_U, W_M) + Z_{UM}$, where W_M is a vector of supply variables such as weather and input prices and Z_{UM} is the tariff on tomatoes imported into the United States from Mexico. In the absence of regulation, the equilibrium is determined by equating demand and supply: $D(X_U^*, V_U) = P^* = S(X_U^*, W_M) + Z_{UM}$. If the reference price (floor), \underline{P} , is below P^* , then the equilibrium is (P^*, X^*) . If the reference price is binding, $P^* \leq \underline{P}$, then the Mexican suppliers divert enough output to Canada or to the processing sector so that the price rises to \underline{P} and the output is such that the quantity demanded and sold, \underline{X}_U , is determined by $\underline{P} = D(\underline{X}_U, V_U)$.

If all three countries engage in trade, additional pairs of equations hold for each bilateral trade arrangement. If we had daily data by tomato variety for all relevant prices, domestic production levels, trade flows, exogenous variables, tariffs, and the VPR, we could estimate a structural switching model between all trading partners.

Unfortunately, we cannot estimate such a structural switching model for three reasons. First, we do not have Mexican production information and hence cannot estimate a structural

Mexican export equation. Second, we do not observe whether the VPR is binding for each observation because our data are aggregated over time (by month) and over grade of tomato. Rather, we only observe the percentage of transactions that the VPR is binding during a month. Thus, even if we could estimate a supply function, we could not estimate a traditional switching equation given that we do not observe the daily state of nature. Third, these countries engage in simultaneous bilateral trade, which cannot be explained without details on the location of shipments, qualities of tomatoes shipped, and other factors that we do not observe.

Because we cannot estimate a structural, switching model, we estimate quasi-reduced-form export equations: the quantity of fresh tomatoes exported from Country i to Country j , X_{ij} , is a function of exogenous variables from the underlying supply and demand equations for the United States (U), Canada (C), and Mexico (M), and the various government border measures:

$$X_{ij} = f_{ij}(V_U, V_C, V_M, W_U, W_C, W_M, \mathbf{Z}, B, B_{-1}),$$

where V_i is a vector of exogenous demand variables in Country i , W_i is a vector of exogenous supply variables for Country i , \mathbf{Z} is a vector of all the bilateral tariffs, and B and the lag of B , B_{-1} , measure the percentage of time that the VPR binds within a month. We include the lag because Mexican exporters often hold their shipments at the southern U.S. border for a week or two, hoping for prices to increase. Consequently, a binding constraint might have an effect in the following month.

Bilateral Trade and Seasonality

In a simple excess demand and supply model, a country is only an exporter or only an importer of a single product in any given period. However, the United States simultaneously imports from and exports to Canada in each month.⁵

This two-way trade occurs because of differences in seasonality, quality, and geography that are obscured by national data. For example, in the winter, the United States often imports in the west and exports in the east. The pattern is reversed in the summer. If we consider only net trade, we could not determine the effect of the trade barrier on Canadian exports to the United States, because they are almost always smaller than the U.S. exports to Canada, and would net out. Therefore, we consider each bilateral export quantity separately.

Because the shippers and regions differ between the summer and the winter, we estimate the systems of equations for the two seasons separately. However, there is some overlap, so the months are not exclusive—winter includes the months from December to June. This time-frame corresponds with approximately 90 percent of the shipments from Florida and Sinaloa, Mexico. Summer includes the months from June to December, which covers 98 percent of the shipping season of California and Baja, Mexico. Canada exports in both seasons, shipping from late April to October. Our reported results for the policy variables hold whether the summer is defined as beginning in April as opposed to May, or ending in November instead of December.

⁵ Likewise, even though Mexico exports large quantities of fresh tomatoes to the United States, the United States exports some tomatoes to Mexico. We do not report the U.S. to Mexico export equation because these exports are relatively small and none of the policy variables had statistically significant effects in that equation. Including it has negligible effects on the other equations.

Paste

If they cannot sell their fresh tomatoes at a high enough price, Mexican firms convert some fresh tomatoes into paste, which they then ship to the United States. However, Mexico does not export paste to the United States in every time period, so we separately estimate the paste equation using a tobit model. Although paste is primarily produced using winter tomatoes, paste is storable, and paste is exported year-round from the same producers. Thus, we did not estimate separate equations for paste exports by seasons.

Data and Variables

Our data set includes the monthly quantities of tomatoes traded among Canada, the United States, and Mexico, as well as imports into the United States from other countries, from January 1989 to November 2001.⁶ The U.S. Department of Agriculture reports weekly prices at which Mexican tomatoes were imported into the United States.⁷ We include a variety of exogenous supply variables. Our measures of weather shocks include temperature and rainfall variables for various cities in California, Florida and Sinaloa, Mexico which were chosen as representative of the primary outdoor growing regions. The weather data come from the National Climatic Data Center for the United States.⁸ Weather does not have the same effect on

⁶ Statistics Canada (www.statcan.ca/trade/scripts/trade_search.cgi), USDA import data (www.fas.usda.gov/ustrade/USTImFatus.asp?QI=), and the USITC *Tomato Monitor* for various years.

⁷ The USDA-AMS supplied unpublished data at our request for import prices at Nogales, Otay Mesa, and Laredo.

⁸ *Summary of the Day*, Boulder, CO: Earth Info, 2002; *Global Climate*, Boulder, CO: Earthinfo, 2002; Because weather variables were not available for Baja, Mexico for the entire time period, we used temperatures in the Imperial Valley, California as a proxy for weather patterns in Baja California and to supplement the information from Mazatlan, in Sinaloa, Mexico. A number of observations of monthly weather variables are missing for the Canadian and Mexican data. Missing values were replaced by monthly averages and totals from daily data obtained from a website with historical daily weather reports from the Weather Underground (www.wunderground.com/global/stations/76458.html).

production throughout the year. For example, rain during the growing season can be beneficial, but rain late in the crop year may delay the harvest and cause the fruit to rot. Thus, rain and temperature variables were interacted with dummies for months during the growing season. A drought proxy was calculated by taking the cumulative rainfall in the year preceding the harvest and dividing by the ten-year average. Frost damage in winter crop was captured by the minimum temperature during the growing winter months. Heat stress was captured using maximum temperatures during the early summer months. Other supply variables include price indexes for Canadian energy prices, to reflect greenhouse production costs, as well as fertilizer and agricultural chemicals for both Canada and the United States.⁹

Our exogenous demand variables are GDP for the three markets, a yearly and monthly time trend, and the monthly time trend squared. We also include exchange rates between Canada and the United States, and Mexico and the United States.¹⁰ All monetary variables are in real dollars. To allow for lagged effects (and to avoid autocorrelation problems), we included a one month lag of all export quantities.

Each country imposed small tariffs on fresh tomato imports during this period. Because of the possibility of trade diversions, we include the vector Z of bilateral tariffs in each export equation. During this period, tariffs among the three NAFTA countries were falling, and the reduction was highly correlated. Because the U.S. tariff on Canadian imports and the Canadian

⁹ Statistics Canada 2002 and 2003, CANSIM II matrices (cansim2.statcan.ca/cgi-win/CNSMCGI.EXE?LANG=E&CANSIMFILE=CII/CII_1_E.htm); USDA-ERS, Farm Financial Data (www.ers.usda.gov/Briefing/Finance).

¹⁰ Canadian fiscal data came from the Bank of Canada, <http://www.bank-banque-canada.ca/en/rates/index.html#price>, the U.S. Federal Reserve Board, <http://www.federalreserve.gov/>, and the Bank of Mexico. All data from the Banco del Mexico came from *Economic and Financial Data for Mexico* (www.banxico.org.mx/siteBanxicoINGLES/eInfoFinanciera/infcarteleraelectronica/imf.html).

tariff on U.S. imports were reduced annually by the same amount, the correlation coefficient between them is 0.98. The correlation coefficient between the Canadian tariffs on U.S. and on Mexican imports is 0.95 and that between the U.S. tariff on Canadian imports and the Canadian tariff on Mexican imports is 0.93. The lowest observed correlation between tariffs was 0.81 (between the U.S. tariff on Canada and the Mexican tariff on the United States). Thus because the tariffs are highly collinear, we could not include all the tariffs in each equation, so we include only the U.S. tariff on Mexican imports and the U.S. tariff on Canadian imports.

Finally, we include a variable B , the fraction of a month that the restraint is binding. To calculate B , we use observations from the border crossing trade, which record the type of tomato, the size of container and a weekly price range, but not the quantity of each. Consequently, what we observe is the percentage of observations of tomato grades and container size during a week for which the constraint was binding. The constraint is never binding for all types and containers of tomatoes during a month, hence B is always less than one.

Results

We start by estimating a system of linear equations for fresh tomato exports to examine trade diversion and a tobit paste equation to measure the diversion of fresh Mexican tomatoes into processing. Then, we simulate total annual effects taking account of both types of diversions.

Because the degree to which the floor price is binding, B , may be endogenous, we need an instrument. Appendix 1 discusses how to construct an appropriate instrument given that B is censored at zero. We use tobit to estimate a percentage binding equation, $B = T(V, W, \underline{P})$, where the explanatory variables are the various weather, cost and exchange rate variables listed above, and the floor price. The floor price was changed annually at first and then seasonally in 1998, so

that it changed nine times during the VPR period. Although the floor price is undoubtedly affected by lobbying, it is unlikely that the exact level at any point in time is a response to trade flows in that same month. The instrumented binding variable captures much of the variation of the original percent binding variable, with a correlation coefficient of 0.94.

We test whether the percentage binding measure is endogenous using a Hausman-Wu test, as described in Appendix 1. The Hausman-Wu test compares results from the consistent estimator using this instrument to the ordinary least squares estimate. We cannot reject the hypothesis that the ordinary least squares estimators are consistent for most of the equations at the 0.05 level, however, we can reject the hypothesis for Mexican exports to Canada and Canadian exports to the United States in the summer.¹¹ Consequently, we report three-stage least squares results for each season, but note that the ordinary least squares coefficient estimates are virtually identical.

Estimated Fresh Tomato Export Equations

We report the estimated coefficients on only the government policy variables for the fresh tomato equations for summer and winter in Table 2.¹² (The table in Appendix 2 contains all the coefficients for the fresh tomato equations.) For each season, the first row shows the coefficient and asymptotic standard error for B , the percent binding measure in the current month. The second row shows the coefficients for B_{-1} , the lagged percent binding variable. For

¹¹ The p statistics on these Hausman-Wu tests are 0.75, 0.55, 0.65, 0.30, and 0.25 for Mexico to the United States, United States to Canada, Canada to the United States, Mexico to Canada and the Rest of the World to the United States for winter respectively. The corresponding p statistics for the summer are 0.99, 0.06, 0.39, 0.04, and 0.35.

¹² For all equations, we cannot reject the hypothesis of spherical error terms at the five percent level based on the Durbin- h test. For the system of winter regression equations, we obtain a test statistic of $\chi^2(15) = 17.75$ (0.28) for an AR(3) model. For the summer regression equations, $\chi^2(15) = 12.37$ (0.65) for AR(3).

the winter season, the percent binding variable is statistically significantly different from zero at the 0.05 level for exports from Mexico to the United States and from Canada to the United States. The lagged percent binding coefficient is statistically significantly different from zero for exports from the United States and Mexico to Canada, although the latter is only significantly different from zero at a ten-percent level. For the summer, the percent binding coefficient is statistically significant for Mexico and Canada to the United States, and the lagged percent binding is statistically significant for Canada to the United States. The third row reports the sum of the two binding coefficients, which is the “long-run” effect. The long-run effect is statistically significantly different from zero in half the equations, Mexico to the United States in the summer, the United States to Canada in the winter, and Canada to the United States in both seasons. The positive coefficient on the lagged binding variable on Mexican winter exports to the United States indicates that some Mexican tomatoes blocked when the VPR is binding enter into the United States one month later, resulting in a small long-run effect of the VPR. When we ran the regression with a dummy variable for the VPR period, the results for the binding and lagged binding variables in both regressions remained qualitatively the same.

Other coefficients largely have the expected effect on trade flows. A decrease in the Mexican or Canadian currency relative to the US dollar increases tomato exports from Mexico and Canada respectively, and an increase in the strength of the US dollar decreases exports from the United States to Canada. Similarly, a stronger Canadian dollar decreases Canadian imports from both Mexico and Canada. While the signs are consistent in both seasons, these exchange rate effects are statistically significantly different from zero in the summer, but not in the winter.

Better production conditions also increase exports. Higher US minimum temperatures in the winter and spring and lower maximum temperatures in the summer, generate higher exports

from the United States to Canada, and lower exports from Canada to the United States. More annual rain near the Mexican growing regions increases Mexican exports to the United States and Canada in both seasons. In general, higher input prices in a country correspond to lower exports and higher imports, although these coefficients are rarely statistically different from zero. One problem with the specific identification of these coefficients may be that input prices are highly correlated in the three countries.

Demand is represented by GDP per capita. Higher GDP in the purchasing country tends to result in higher imports for the Canada and the United States, with the notable exception of exports from Mexico to the United States. We can only speculate that Mexican tomatoes may be perceived as an inferior product by U.S. consumers.

Last, tariffs mostly had the expected effects, in that a higher tariff decreases trade flows, particularly between the United States and Canada. However, as noted above, the tariffs are highly positively correlated across countries and are highly negatively correlated with the yearly time trend. We believe this high negative correlation explains the positive coefficient on the U.S. tariff on Mexico in Mexican exports to the United States since the coefficient on the yearly time trend is also positive and highly significant.

Robustness Checks and Hypothesis Tests

As a robustness check, we estimate the regression using only three years of data from before the VPR period. We need to include at least three years to capture the changes in tariffs introduced with NAFTA, but we want to check to see if our results are affected by the earlier years. The effects of the binding and lagged binding variables are qualitatively unchanged.

As a second robustness check, we test whether the investigation leading to the VPR has an effect by including a dummy variable for 1996. The investigation dummy does not have a

statistically significant effect at the 0.05 level in the summer model, but does in the winter model. Specifically, Mexico decreases its exports by approximately 23 percent in the year of the dumping investigation. Because winter exporters are more concentrated than their summer counterparts, this effect may well be strategic behaviour intended to reduce trade tensions. However, other coefficients remain essentially unchanged when we include this dummy.

We test whether the summer and winter system of equations differ. We reject at the 0.05 level the null hypothesis that that the coefficients for the binding measure, and the lagged binding measure are jointly the same in both summer and winter for all bilateral export equations except for exports from Mexico to the United States and Mexico to Canada.

Table 3 reports χ^2 test statistics on several joint hypothesis tests on the policy variables. Panel A presents tests that both of the percent binding coefficients equal zero in each of our equations in each season. We can reject the null hypothesis of no effect at the 0.05 level for three of four trade flows in the winter, for Canadian exports to the United States in the summer.

Panel B shows that we cannot reject the hypothesis that the percent binding coefficients are zero collectively across all the equations (“all trade”) or across all the “trade diversion” equations, which excludes the “Mexico to U.S.” equation. The hypothesis that all the coefficients are zero is strongly rejected for “all trade” and “trade diversion” equations in each season.

Thus, the policy has statistically significant effects. Does it have an economically significant effect on the number of fresh tomatoes sold in the United States? To answer this question, we conduct two simulation experiments. Table 4 measures the policy’s effect on shipments of fresh tomatoes during only those months in which the price constraint was binding (the binding measure or the lagged binding measure were nonzero). The price restriction is

binding 30 percent of the time on average during the time the VPR is in effect. The first column shows the change in the thousand tonnes of tomatoes shipped: the product of the binding measure times its coefficient plus the lagged binding measure times its coefficient averaged over all months in which either the price is binding. The second column shows the change given in the first column as a percentage of the monthly average trade flow estimated for the period when the policy binds for at least some tomato shipments. During these binding periods, direct monthly winter exports from Mexico to the United States fall by 8.56 thousand tonnes (first column, first row of the winter panel) or 11 percent of the average exports when the VPR is in effect. The next three rows show the diversion effect: Shipments from the United States to Canada decrease by 1.35 thousand tonnes, or 12 percent, but shipments to the United States from Canada increase by 1.47 thousand tonnes on average, or 26 percent. As a consequence, net imports into the United States fall by only 5.74 thousand tonnes. That is, 33 percent (second column, last row) of the drop in Mexican exports is offset by shipments from elsewhere during the winter. During the summer, 34 percent of the direct effect of the VPR is offset.

Paste Equation

The border measure also has an effect on processed products. We estimate the export of paste from Mexico to the United States as a function of a number of cost, weather and exchange rate variables, and as a function of the border measure for November through June, the primary time of the year when paste was exported (Table 5). Processing occurs in the two to three months following harvest, so most RHS variables were lagged two months with the exception of those that would affect trade of the processed product itself, such as the exchange rate. Because paste is not exported in all of these months, we estimate the equation using a tobit.

For the three months following the month in which the VPR is binding, Mexican tomato paste exports to the United States increase by 1.08 tonnes, or 90 percent of the exports during the period the VPR is in place. Given that it takes 4 tonnes of fresh tomatoes to make one tonne of paste,¹³ 4.3 thousand tonnes of tomatoes per month, or 8 percent of monthly fresh tomato exports, are diverted from the U.S. fresh market into the U.S. paste market when the border measure is binding.

Annual Simulations

We can use our estimates of the fresh tomatoes and paste equations to simulate the annual effects of the policy. The annual numbers in the first column of Table 6 capture the full effect of the policy from the percent binding and the lagged percent binding variables.¹⁴ The simulated numbers are annual averages for the VPR period, when the border measure is binding an average of 17 percent of the time. The second column shows the percentage diversion effect: the change in shipments as a percentage of the corresponding average monthly trade flows during the VPR period.

The direct effect of the policy is to reduce Mexican export to the United States by 42.6 thousand tonnes per year. Exports would be 7 percent higher were the policy not in effect.

In addition to the direct effect, there were sizeable fresh tomato diversions and diversions into processing. Around 12 percent of the diverted tomatoes enter the United States one period after the VPR is binding, so trade diversion over time reduces the effect of the VPR. For Mexico, the drop in exports to the United States is further offset by shipping 300 tonnes more

¹³ Based on information from Hunts (www.hunts.com/HL01-HealthyLiving.jsp?mnav=healthy) and University of Georgia (www.fcs.uga.edu/pubs/PDF/FDNS-E-43-2.pdf).

¹⁴ Our seasons for the fresh exports overlap. To compensate for that, we obtain the annual fresh numbers by multiplying each seasonal (monthly) number by six and summing the results for the two seasons.

tomatoes to Canada (3 percent of normal shipments) and, more importantly, converting 19.8 thousand tonnes (fresh equivalent) into paste, which are then exported to the United States. Thus, net Mexican exports fell by 16.7 thousand tonnes, or only 39 percent of the gross drop in Mexican exports to the United States.

The drop in U.S. imports from Mexico is offset by increases in shipments of 11 thousand tonnes fresh tomatoes from Canada (12 percent of regular shipments) and a decrease in exports from the U.S. to Canada of 3.4 thousand tonnes (3 percent of regular shipments). In total, the net effect of the VPR is to decrease imports by only 23.0 thousand tonnes, as reported in the eighth row of table 6. Thus, 46 percent of the direct effect was offset by this indirect effect of diversion of fresh tomato exports to the U.S. domestic market. If we also include the paste diversion, then the VPR decreases imports of fresh-tomato equivalents by only 6.6 thousand tonnes.

How important are these effects on U.S. fresh tomato prices? Given an estimated demand elasticity of -0.55 (Malaga et al. 2001) and noting that U.S. consumption is slightly over 2 million tonnes of fresh tomatoes (USDA-ERS 2007), the direct reduction in Mexican imports would cause the price of fresh tomatoes to increase by 4 percent. However, because diversions offset over half of the direct reduction in Mexican exports of fresh tomatoes to the United States, the price increase is only 2.1 percent.¹⁵ Indirect supporting evidence of this mitigation effect is that the average farm-level price rose by only 2 percent from the period before the VPR (1988-1996) to the period when the VPR was in effect (1997-2002).

¹⁵ This calculation ignores any changes in U.S. domestic production and the effect on the price of paste.

Conclusions

Voluntary price restrictions induce substantial diversions of tomato exports to other countries and into processing. At the urging of U.S. producers, the United States negotiated a voluntary price restraint (VPR) on fresh tomato imports from Mexico. This voluntary floor price on Mexican fresh tomato exports meets the U.S. producers' objective of blocking some tomato exports when prices were low, leading to a decrease of 42,600 tonnes of Mexican fresh tomato exports when the floor price is binding. If this drop had been the sole effect of the border measure, the U.S. tomato price would have increased by about 4 percent.

However, the border measure changed the timing of shipments from Mexico and affected trade among third parties. Some of the blocked Mexican tomatoes made their way into the United States one month later, leading to an annual decrease of 37,400 tonnes of Mexican fresh tomatoes in the U.S. market. Further, by making the U.S. market more attractive, the reference price attracts fresh tomato exports from other countries. In particular, Canadian growers benefit from this border measure, increasing their annual exports to the United States by 12 percent and facing three percent fewer imports from the United States. These diversions of fresh tomatoes offset 46 percent of the drop in Mexican exports of fresh tomatoes to the United States. As a consequence, the implied U.S. price increase from the VPR was only 2.1 percent rather than 4 percent.

Last, the VPR also encourages diversion into processed product. Mexico diverts over half of fresh exports from the United States into tomato paste production. This paste production is then shipped to the United States, resulting in a 34 percent increase in paste exports. Although paste is clearly an imperfect substitute for fresh tomatoes, when one includes this diversion to

paste exports, a total of 85 percent of the direct effect of the floor price is offset by the mix of increased paste exports plus fresh imports from other countries.

Thus, we find that although the U.S.-Mexico VPR has trade distorting effects for the United States and Mexico, the resulting increased shipments from Canada and other countries are substantial and sharply reduce the protectionist effect of the border measure in the United States. Further, the VPR on the raw product encourages Mexico to process the tomatoes and export them to the United States, which increases competition to U.S. processors. That is, the protectionist nature of the VPR is substantially undermined by diversions.

Given producers face losing the total value of their crop if the tomatoes rot before being sold, this high level of trade diversion for fresh tomatoes is perhaps not surprising. Baylis et al. (2009) find that perishable goods see a higher degree of trade diversion. Therefore, the magnitude of the results for tomatoes cannot be extrapolated to other non-perishable products, although the qualitative results hold.

The trade diversion studied here is another example of unintended consequences of trade barriers. It is interesting that while there is only a small long-run effect of the VPR on trade flows from Mexico to the United States in percentage terms, the effect of trade diversion is quite substantial, particularly for exports from Canada and exports of paste from Mexico. Thus, trade diversion can increase import competition faced by other industries and regions, which may incite further protectionist actions. Notably, several years after the floor price was imposed by Mexico, the United States filed an AD suit against Canadian tomato imports in 2001, causing the Canadian industry to respond with its own AD case against US tomato imports one year later.

Trade diversion caused by contingent protection is not unique to tomato trade. The U.S. steel tariffs imposed in 2002 not only increased the cost of production for U.S. industries that use

steel, the EU argued that concern over trade diversion from these tariffs caused them to introduce import tariffs of their own later that same year (European Commission 2002). New trade laws have gone as far as to enshrine concerns over trade diversion. The new China Import Safeguard under the WTO allows countries to protect themselves against an anticipated surge in imports from China diverted by a safeguard imposed by a third country (Bown and Crowley 2007b). Thus, while trade diversion may mitigate against the effectiveness of contingent protection, it may also exacerbate other trade tensions. Understanding the type and magnitude of trade diversion is therefore important when considering calls for contingent protection.

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Table 1**Average Monthly Exports within and to North America, 1989-2001***
(in 1,000 Tonnes)

<i>Exports</i>	<i>Annual Mean</i>	<i>Winter Mean</i>	<i>Summer Mean</i>
Mexico to U.S.	41.19 (28.43)	55.03 (29.48)	24.35 (11.88)
Canada to U.S.	3.23 (5.37)	2.74 (5.42)	3.89 (2.52)
ROW to U.S.	2.15 (1.84)	2.21 (1.84)	2.19 (1.85)
Mexico to Canada	1.77 (2.17)	2.79 (2.31)	0.39 (0.41)
U.S. to Canada	10.72 (2.62)	10.85 (2.68)	10.98 (2.52)
ROW to Canada	0.59 (1.42)	0.60 (1.29)	0.66 (1.55)
U.S. to Mexico	1.06 (1.88)	0.37 (0.79)	1.71 (2.23)

Sources: USITC and Statistics Canada (2002)

Table 2
VPR Government Policies

	<i>Mexico to U.S.</i>	<i>U.S. to Canada</i>	<i>Canada to U.S.</i>	<i>Mexico to Canada</i>
	<i>Coef. (ASE)</i>	<i>Coef. (ASE)</i>	<i>Coef. (ASE)</i>	<i>Coef. (ASE)</i>
Winter				
Percent binding	-29.53 (12.96)	2.28 (1.55)	5.82 (1.32)	-1.50 (1.20)
Lagged percent binding	10.40 (14.13)	-6.73 (1.69)	-0.73 (1.46)	2.54 (1.30)
Combined	-19.12 (19.04)	-4.65 (2.28)	5.09 (1.96)	1.04 (1.75)
Summer				
Percent binding	-13.49 (6.64)	1.63 (1.64)	1.80 (0.83)	-0.35 (0.20)
Lagged percent binding	-3.35 (5.34)	-0.70 (1.35)	3.67 (0.67)	0.19 (0.17)
Binding combined	-16.84 (7.59)	0.93 (1.89)	5.58 (0.94)	-0.35 (0.20)

Note: A bold coefficient indicates that we can reject the null-hypothesis that the coefficient is zero at the five percent level.

Table 3
Hypothesis Tests

(A) Chi-Square Tests that Both Percent Binding Coefficients Equal Zero

	<i>Mexico to U.S.</i>		<i>U.S. to Canada</i>		<i>Canada to U.S.</i>		<i>Mexico to Canada</i>	
	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>
Winter	5.69	0.05	24.31	0.00	26.31	0.00	5.28	0.07
Summer	5.31	0.07	1.09	0.58	42.16	0.00	3.72	0.16

(B) Chi-Square Test Statistics across Equations*

	<i>Percent binding</i>		<i>Lagged Percent binding</i>		<i>Combined</i>	
	χ^2	<i>p</i>	χ^2	<i>p</i>	χ^2	<i>p</i>
<i>Winter</i>						
All Trade	28.77	0.00	25.10	0.00	53.90	0.00
Trade Diversion	22.83	0.00	23.72	0.00	46.47	0.00
<i>Summer</i>						
All Trade	10.46	0.06	38.80	0.00	57.76	0.00
Trade Diversion	8.16	0.09	32.69	0.00	47.04	0.00

* Includes the rest-of-the-world to United States equation.

Table 4
Change in Monthly Exports when Border Measure Binds in the Current and Previous Months

Winter

	<i>Thousand Tonnes</i>	<i>Percent</i>
Direct Effect		
Mexico to United States	-8.56	-11
Diversions Effect		
United States to Canada	-1.35	-12
Canada to United States	1.47	26
Net Effect	-5.74	
% of direct effect offset by diversion		33

Summer

	<i>Thousand Tonnes</i>	<i>Percent</i>
Direct Effect		
Mexico to United States	-3.91	-13
Diversions Effect		
United States to Canada	0.93	3
Canada to United States	1.59	16
Net Effect	-2.59	
% of direct effect offset by diversion		34

Note: In the second column, the percentage is calculated relative to the average monthly trade flow for only those months during which the price constraint was binding.

Table 5
Summary of Results of Tobit of Trade Barriers on Monthly Paste Exports

	<i>Coefficient</i> <i>(ASE)</i>
Percent binding (t-1)	-0.31 (2.76)
Percent binding (t-2)	-1.44 (2.39)
Percent binding (t-3)	5.46 (2.71)
Combined	3.71 (5.31)

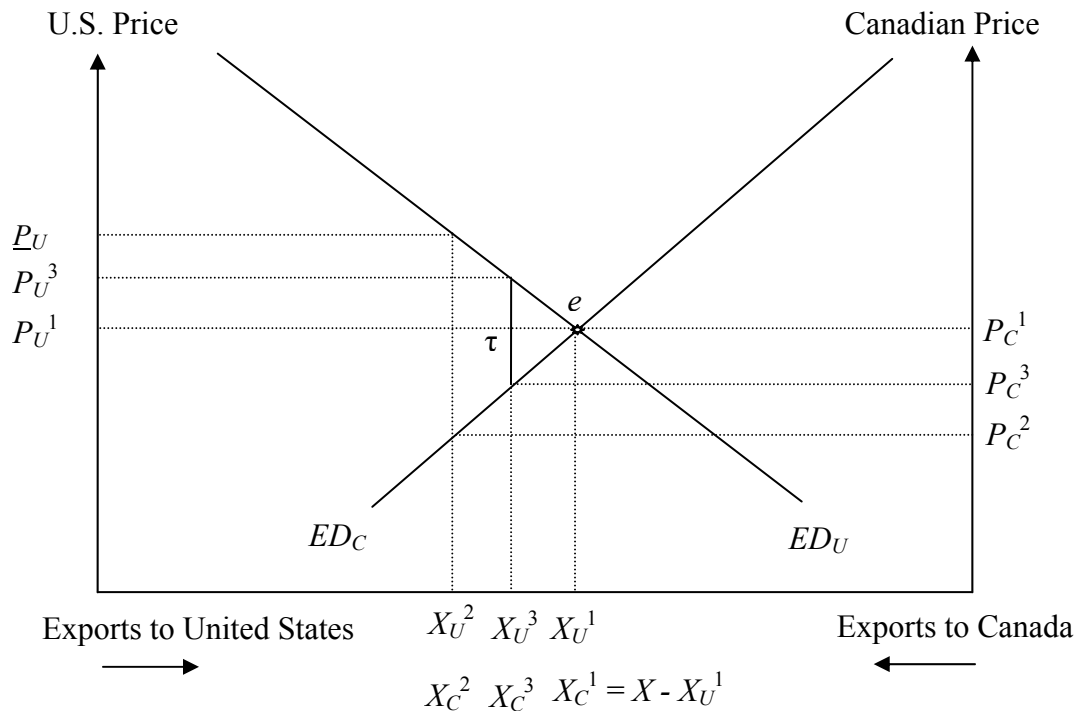
Table 6
Annual Effect of Border Measure

	<i>Change in 1,000 Tonnes</i>	<i>Percent of average trade flows*</i>	<i>Percent reduction in Mexican exports to US</i>
Direct effect on fresh tomatoes exports from Mexico to the U.S.	-42.6	-7	
Net effect after one lag	-37.4	-6	12
Diversion effects on fresh tomatoes exports			
United States to Canada	-3.4	-3	8
Canada to United States	11.0	12	26
Mexico to Canada	0.9	3	1
Diversion into Mexican paste exports to the U.S. (fresh tomato equivalent)	19.8	35	-54
Net effect on Mexican fresh tomato exports (including paste)	-16.7		-39
Net effect on U.S. imports of fresh tomatoes (fresh only)	-23.0		-46
Net effect on U.S. imports of fresh tomatoes (including paste)	-6.6		-84

* The percentage is of average shipments during the years when the VPR was in effect.

Figure 1

Mexican Tomato Exports to the United States and Canada



Appendix 1: An Appropriate Instrument for the Hausman-Wu Endogeneity Test¹⁶

Because the variable that measures the degree to which the border measure binds (the percent of shipments for which the price of the imported Mexican tomatoes equals the reference price), y_1 , may be endogenous in our system of equations, we test for endogeneity using a Hausman-Wu test. To conduct this test, we need a consistent estimate. To obtain such an estimate, we need an instrument for our potentially endogenous variable.

Our first step is to estimate a y_1 -equation,

$$y_1 = x_1' \beta_1 + \varepsilon_1, \quad (\text{A1})$$

where x_1 is a matrix of exogenous variables that are not affected by the quantity of trade flows, and ε is assumed to be distributed normally. (To avoid autocorrelation problems, one of the exogenous variables is $y_{1,t-1}$.) Because y is censored at zero (fewer than half of the observations are non-zero), we estimate Equation (A1) using tobit.

The expectation of y_1 is

$$E(y_1) = \Phi(x_1' \beta_1 / \sigma_{11}) [x_1' \beta + \sigma_{11} \lambda_1], \quad (\text{A2})$$

where $\lambda_1 = \phi(x_1' \beta_1 / \sigma_{11}) / \Phi(x_1' \beta_1 / \sigma_{11})$.

We use the predicted value from our tobit equation as an instrument in the second stage. The second stage is a linear equation giving the quantity of trade between two countries as a function of various excess supply and demand variables

$$y_2 = x_2' \beta + \gamma_2 y_1 + \varepsilon_2, \quad (\text{A3})$$

¹⁶ We are grateful to Jeffrey LaFrance for suggesting this methodology.

where y_2 is the quantity exported from one country to another, x_2 is a matrix of exogenous variables that affect supply and demand, including the other border measures than y_1 .

To ensure that the predictor of y_2 is consistent, we must correct for the correlation between the error terms in the two equations. However, a correction must be made for the correlation between the error terms of the two equations:

$$E(\varepsilon_1 \varepsilon_2) = \rho \sigma_{11} \sigma_{22}, \quad (\text{A4})$$

where $\rho = \sigma_{12} / (\sigma_{11} \sigma_{22})$. We can write the conditional expectation of ε_2 given ε_1 as

$$E(\varepsilon_2 | \varepsilon_1) = \rho \left(\frac{\sigma_{22}}{\sigma_{11}} \right) \varepsilon_1, \quad (\text{A5})$$

$$E_{e_1^3 - x_1 \phi_1} E(e_2 | e_1) = r \frac{\sigma_{22}}{\sigma_{11}} E(e_1 | e_1^3 - x_1 \phi_1) = r s_{22} \frac{f(-x_1 \phi_1 / s_{11})}{F(x_1 \phi_1 / s_{11})}. \quad (\text{A6})$$

Thus, a consistent estimator for y_2 is

$$\begin{aligned} E(y_2 | \varepsilon_1) &= \left[1 - \Phi(x_1' \beta_1 / \sigma_{11}) \right] E(y_2 | \varepsilon_1 \geq -x_1' \beta_1) + \Phi(x_1' \beta_1 / \sigma_{11}) E(y_2 | \varepsilon_1 < -x_1' \beta_1) \\ &= \left[1 - \Phi(x_1' \beta_1 / \sigma_{11}) \right] \left[x_2' \beta_2 + \gamma_2 (x_1' \beta_1 + \sigma_{11} \lambda_1) + \rho \sigma_{22} \frac{\phi(x_1' \beta_1 / \sigma_{11})}{\Phi(x_1' \beta_1 / \sigma_{11})} \right] \\ &\quad + \Phi(x_1' \beta_1 / \sigma_{11}) \left[x_2' \beta_2 + \gamma_2 (x_1' \beta_1 + \sigma_{11} \lambda_1) + \rho \sigma_{22} \frac{\phi(x_1' \beta_1 / \sigma_{11})}{\Phi(x_1' \beta_1 / \sigma_{11})} \right]. \end{aligned} \quad (\text{A7})$$

which simplifies to

$$E(y_2 | \varepsilon_1) = x_2' \beta_2 + \gamma_2 (x_1' \beta_1 + \sigma_{11} \lambda_1) + \rho \sigma_{22} \lambda_1. \quad (\text{A8})$$

We use the estimate in Equation (A8) to perform the Hausman-Wu test for endogeneity.

Appendix 2: Full Set of Estimated Coefficients for Fresh Tomato Export Equations

Winter

	Mexico to US	US to Canada	Canada to US	Mexico to Canada	ROW to US
Percent Binding	-29.528	2.279	5.819	-1.499	-0.635
	(12.958)	(1.548)	(1.325)	(1.200)	(0.782)
Bercent Binding(t-1)	10.408	-6.931	-0.733	2.537	-1.165
	(14.131)	1.690	(1.461)	(1.302)	(0.847)
Peso/US\$	11.428	-0.940	-0.749	1.131	-0.140
	(7.032)	(0.841)	(0.723)	(0.646)	(0.421)
C\$/US\$	-0.754	0.505	-0.203	-0.228	-0.030
	(2.117)	(0.253)	(0.218)	(0.194)	(0.127)
US tariff on Mexican imports	-5.092	2.671	-2.094	-0.037	0.798
	(10.960)	(1.311)	(1.127)	(1.006)	(0.656)
U.S. tariff on Canadian imports	-3.641	-0.561	0.054	-1.143	-0.194
	(12.877)	(1.540)	(1.324)	(1.183)	(0.771)
Dec. rain in Mazatlan	-0.439	0.023	-0.053	0.013	-0.009
	(0.266)	(0.032)	(0.027)	(0.024)	(0.016)
Feb. ave temperature in Imperial Valley, CA	-1.093	0.320	-0.253	-0.204	0.039
	(1.462)	(0.175)	(0.150)	(0.134)	(0.087)
May max. temperature in Imperial Valley, CA	-0.084	0.143	-0.117	-0.040	0.073
	(0.619)	(0.074)	(0.064)	(0.057)	(0.037)
Cumulative annual rainfall in Mazatlan	16.969	0.039	-0.419	0.569	-0.605
	(9.270)	(1.109)	(0.953)	(0.852)	(0.555)
Jan average rain in Florida	62.722	4.927	12.280	-10.303	5.791
	(67.220)	(8.040)	(6.912)	(6.173)	(4.022)
Minimum temerature in Florida in Dec	0.008	0.006	0.030	-0.024	-0.001
	(0.402)	(0.048)	(0.041)	(0.037)	(0.024)
Minimum temerature in Florida in Feb	-0.571	0.155	-0.118	-0.015	0.024
	(0.524)	(0.063)	(0.054)	(0.048)	(0.031)
Cumulative annual rainfall in Florida	-6.695	0.571	-0.833	3.172	-0.843
	(18.443)	(2.206)	(1.897)	(1.694)	(1.104)
(real) Canadian energy price (t-1)	0.185	-0.007	-0.003	0.016	0.025
	(0.180)	(0.022)	(0.019)	(0.017)	(0.011)
(real) Canadian input price in March	0.248	-0.019	-0.023	0.006	-0.010
	(0.196)	(0.023)	(0.020)	(0.018)	(0.012)
(real) Canadian agricultural wage in May	-26.750	2.914	-3.930	-1.073	1.311
	(17.791)	(2.128)	(1.829)	(1.634)	(1.065)
(real) Ag. chemical price in Nov.	4.127	-0.355	0.309	0.114	0.107
	(1.912)	(0.229)	(0.197)	(0.176)	(0.114)
(real) Fertilizer price in Oct	1.967	0.126	0.062	-0.092	0.154
	(2.014)	(0.241)	(0.207)	(0.185)	(0.121)

(real) Mexican GDP per capita	0.359	-0.039	-0.003	0.025	-0.006
	(0.114)	(0.014)	(0.012)	(0.011)	(0.007)
(real) U.S.GDP per capita	-0.233	-0.006	0.052	-0.004	0.015
	(0.127)	(0.015)	(0.013)	(0.012)	(0.008)
(real) Canadian GDP per capita	-0.754	0.505	-0.203	-0.228	-0.030
	(2.117)	(0.253)	(0.218)	(0.194)	(0.127)

Note: A bold coefficient indicates that we can reject the null-hypothesis that the coefficient is zero at the five percent level, and a coefficient in bold italics is significantly different from zero at the ten percent level.

Summer

	Mexico to US	US to Canada	Canada to US	Mexico to Canada	ROW to US
Percent Binding	-13.487 (6.641)	1.632 (1.637)	1.804 (0.828)	-0.354 (0.201)	-0.082 (0.626)
Bercent Binding(t-1)	-3.352 (5.343)	-0.698 (1.353)	3.674 (0.669)	0.191 (0.166)	0.496 (0.497)
Peso/US\$	3.984 (2.019)	-0.254 (0.495)	0.472 (0.250)	0.243 (0.061)	0.000 (0.188)
C\$/US\$	-0.222 (0.301)	-0.202 (0.074)	0.070 (0.037)	-0.021 (0.009)	0.006 (0.028)
US tariff on Mexican imports	2.338 (1.192)	-0.031 (0.292)	0.204 (0.147)	0.095 (0.036)	0.228 (0.111)
U.S. tariff on Canadian imports	0.337 (3.100)	-1.178 (0.759)	-0.766 (0.384)	-0.081 (0.094)	-1.252 (0.289)
Cumulative annual percipitation in Imperial Valley, CA	2.999 (1.569)	0.283 (0.384)	-0.374 (0.194)	0.110 (0.048)	0.106 (0.146)
April min. temperature in Imperial Valley, CA	-0.075 (0.277)	0.200 (0.068)	0.004 (0.034)	0.007 (0.008)	-0.038 (0.026)
June min. temperature in Stockton, CA	0.211 (0.386)	0.194 (0.095)	-0.140 (0.048)	0.023 (0.012)	0.028 (0.036)
August max. temperature in Stockton, CA	0.025 (0.024)	-0.028 (0.006)	0.000 (0.003)	0.000 (0.001)	-0.012 (0.002)
(real) Canadian energy price (t-1)	0.138 (0.090)	0.022 (0.022)	-0.011 (0.011)	0.007 (0.003)	0.014 (0.008)
(real) Ag. chemical price in May	0.125 (0.663)	0.104 (0.163)	0.022 (0.082)	0.048 (0.020)	0.079 (0.062)
(real) Fertilizer price in March	0.852 (0.675)	-0.106 (0.165)	-0.197 (0.084)	0.007 (0.020)	0.071 (0.063)
(real) Mexican GDP per capita	0.038 (0.069)	0.012 (0.017)	-0.016 (0.009)	0.005 (0.002)	0.000 (0.006)
(real) U.S.GDP per capita	-0.203 (0.080)	-0.013 (0.020)	0.005 (0.010)	-0.006 (0.002)	0.007 (0.007)
(real) Canadian GDP per capita	2.058 (1.080)	0.506 (0.265)	-0.332 (0.134)	0.085 (0.033)	0.072 (0.101)

Note: A bold coefficient indicates that we can reject the null-hypothesis that the coefficient is zero at the five percent level, and a coefficient in bold italics is significantly different from zero at the ten percent level..