A Case Study of U.S. Fresh Tomato Trade among NAFTA Countries

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Abstract

U.S. consumption of fresh tomatoes has been increasing steadily over the last 10 years despite a recent declining trend in domestic production (USDA-NASS 2015). The international market plays a key role in meeting U.S. consumers' demand for fresh tomatoes. Over the last ten years, in volume terms, U.S. imports accounted for about 50% of the U.S. consumption (USITC DataWeb, 2015). Our U.S. NAFTA partners are our main markets for fresh-tomatoes. Unlike previous studies, this study analyzes the U.S. principal supply sources of five tomato cultivars (greenhouse, cherry, grape, roma, and other) and estimates a source-differentiated almost ideal demand system (SAIDS). The study explores if U.S. consumers' preferences for these five tomato varieties are heterogeneous and if source of origin is an intrinsic quality attribute. Source-differentiated Marshallian and Hicksian price and expenditure elasticities are estimated and compared to source-undifferentiated and aggregated estimates. The elasticity estimates reported in this study could be useful to decision makers in establishing U.S. fresh-tomatoes import taxes and price floors, and may also assist growers in monitoring imports and implementing relevant marketing strategies. The elasticity estimates can also be used to project likely import scenarios among our NAFTA partners.

Keywords: fresh-market tomatoes, U.S. import demand for fresh-market tomatoes, tomato varieties, SDAIDS

JEL codes: Q11, R21

Introduction

Tomatoes are the fourth most consumed vegetable in the U.S. (USDA-ERS, 2012). U.S. consumption of fresh-market tomatoes has been increasing steadily over the past several years (Figure 1 and Table 1) despite recent declining trends in U.S. fresh-market tomatoes area planted, area harvested, and production (Figure 2, Figure 3, and Table 2). The international market plays a key role in meeting U.S. consumers' demand for fresh-market tomatoes as U.S. imports account for about 50% of the U.S. consumption in volume terms (Table 1, top section) and for about 60% in terms of the U.S. consumption in terms of value (Table 1, bottom section). This trend emphasizes the importance of a U.S. import demand analysis for fresh-market tomatoes at the disaggregated level for domestic growers.

For more than twenty years now, the main destinations for U.S. exports and source of U.S. imports for fresh-market tomatoes have been Canada and Mexico (Tables 3, 4, 6, 7, 8, 9, and 10). Over the last ten years, U.S. exports to Canada and Mexico account for 77% and 20% respectively (Table 3) while U.S. imports from the same countries account for 10% and 89% respectively (Table 4). From 2005 to 2010, U.S. exports of fresh-market tomatoes to Canada declined from 130,501 metric tons to 87,610 metric tons while from 2005 to 2009 exports to Mexico increased from 13,591 metric tons to 57,722 metric tons (Table 3). For the next four or five years, from 2011 to 2014, exports of fresh-market tomatoes to Canada remained at about 90,800 metric tons, while from 2009 to 2014 exports to Mexico declined to 14,200 metric tons (Table 3). In the case of imports (Table 4), from 2005 to 2014, fresh-market tomatoes imports from Mexico have been increasing, from 801,408 metric tons to 1,389,334 metric tons, while imports from Canada have remained at about 135,000 metric tons.

Table 5 and Figures 4 and 5 identify trends in fresh-market tomatoes by type. In particular, since the late 1990's imports of greenhouse and Roma tomatoes have been rapidly increasing, while grape and cherry tomatoes have remained at about the same level, but imports of all other tomatoes have been decreasing (Figures 4 and 5). The increasing trend for fresh-market greenhouse tomato imports is likely to be the result of the increasing popularity of growing tomatoes in greenhouses. Interestingly, among the fresh-market tomatoes reported in Table 5, the price (unit value) of the greenhouse tomatoes is usually the highest. This means, the increasing import demand for fresh-market greenhouse tomatoes is not generally driven by low prices, but rather by the ability to supply the market (i.e., the time component of utility marketing) since greenhouse tomatoes accounted for 43%, on average, of the U.S. imports from 2005 to 2014 (Table 5).

Mexico and Canada are the main source of U.S. imports of fresh-market greenhouse tomatoes (2005-2014 shares of 96.78% and 1.69% respectively), Roma tomatoes (99.63% and 0.31% respectively), cherry tomatoes (93.09% and 5.82% respectively), and all other tomatoes (96.78% and 1.69% respectively). In the case of grape tomatoes (Table 8), 98.58% of the grapes tomatoes come from Mexico, 1.25% from Dominican Republic, and 0.14% from Canada. Clearly, the U.S. NAFTA partners are the main sources of fresh-tomatoes.

This study employs a source differentiated almost ideal demand system (SDAIDS) to estimate the U.S. import demand for Canadian and Mexican fresh-market tomatoes. The study explores if consumers' preferences for five tomato varieties (greenhouse, Roma, grape, cherry, and other) are heterogeneous and whether source of origin is an intrinsic quality attribute. Unlike previous studies, the study analyzes disaggregated fresh-market tomatoes and considers the principal supply sources (sources of origin). If fresh-market tomatoes from our NAFTA

partners are not perceived as homogenous or if fresh-market tomato varieties cannot be aggregated into one category, previous import elasticity estimates for fresh-market tomatoes may be biased.

Methods and Procedures

Various demand systems have been used to analyze demand for fresh fruits and vegetables, including the Rotterdam model (e.g., Seale et al., 2013), the AIDS (e.g., Thompson, 2003), the linear approximation of the AIDS (e.g., Padilla and Acharya, 2009; Naanwaab and Yeboah, 2012), the full AIDS (e.g., Lopez and Peckham 2016, Lopez and Davis, 2015), the quadratic AIDS (e.g., Thompson, 2003), first difference version of the AIDS (e.g., Jung et al., 2005), the inverse AIDS (e.g., Grant and Foster, 2005), and source differentiated almost ideal demand system (SDAIDS) (Henneberry et al., 1999; Yang and Koo, 1994). This study follows Henneberry and Mutondo (2009) and employs a source differentiated almost ideal demand system (SDAIDS) to estimate the U.S. import demand for Canadian, Mexican, and rest-of-the-world fresh-market tomatoes.

Deaton and Muelbauer's (1980) AIDS model is considered an arbitrary first order approximation of any demand system. It satisfies the axioms of choice and aggregates perfectly over consumers up to a market demand function without invoking parallel linear Engel curves. The functional form can be used to test the properties of homogeneity and symmetry through linear restrictions on fixed parameters, and is not difficult to estimate. Following Henneberry and Mutondo (2009) and Yang and Koo (1994), the SDAIS model is specified as:

(1) $\quad w_{i_h} = \alpha_{i_h} + \sum_j \sum_k \gamma_{i_h j_k} \ln(p_{j_k}) + \beta_{i_h} \ln\left(\frac{E}{P}\right) + \varepsilon_{i_h},$

where subscripts i and j indicate goods ($i, j = 1, 2, \ldots n$) and h and k indicate source of origin; w_{i_h} is the import expenditure share for good i from source h; p_{j_k} is the price of good j from source k (with j including i and k including h); E is U.S. total expenditure on all goods included in the demand system; α_{i_h}, $\gamma_{i_h j_k}$, and β_{i_h} are parameters, ε_{i_h} is a random term of disturbances, and P is the nonlinear price index.

The demand theory properties of adding-up, homogeneity and symmetry are imposed on the system of equations by restricting parameters in the model as follows:

(2) Adding-up: $$\sum_i \sum_h \alpha_{i_h} = 1, \quad \sum_j \sum_h \gamma_{i_k j_h} = 0, \text{ and } \sum_i \sum_h \beta_{i_h} = 0;$$

(3) Homogeneity: $$\sum_i \sum_h \gamma_{i_h j_k} = 0;$$

(4) Symmetry: $\gamma_{i_h j_k} = \gamma_{j_k i_h},$

where subscripts i and j indicate goods ($i, j = 1, 2, \ldots n$) and h, and k indicate source of origin.

The parameter estimates and the mean expenditure shares are used to estimate the Marshallian (uncompensated) and the Hicksian (compensated) price elasticities as well as the expenditure elasticities. Following Green and Alston (1990), the elasticities are estimated as:

(5) Marshallian Price Elasticity: $e_{i_h j_m} = \dfrac{\gamma_{i_h j_m}}{w_{i_h}} - \dfrac{\beta_{i_h}}{w_{i_h}}\left(\alpha_{i_h} + \sum_l \sum_k \gamma_{l_k j_m} \ln\left(p_{l_k}\right)\right) - \delta_{i_h j_m}$

(6) Hicksian Price Elasticity: $e^c_{i_h j_m} = e_{i_h j_m} + w_{j_m} e_{i_h}$

(8) Expenditure Elasticity: $e_{i_h} = 1 + \dfrac{\beta_{i_h}}{w_{i_h}}$

where subscripts i and j indicate goods ($i, j = 1, 2, \ldots n$) and h, k, and m indicate source of origin; $\delta_{i_h j_m}$ is the Kronecker delta, which is equal to 1 if $i_h = j_m$ and equal to 0 if otherwise.

The equation holding the smallest budget share equation is usually omitted from the demand system estimation. However, after the estimation of the demand system, the parameters of the omitted equation are recovered using equations (2) through (4).

Data and Procedures

Annual data on U.S. imports in volume and value by country for the period 1999-2014 were obtained from the United States International Trade Commission (USITC) Interactive Tariff and Trade DataWeb Version 3.1.0. All data are for fresh or chilled tomatoes on a fresh-weight basis. Due to space limitations, Tables 6 through 10 only report data for the period 2004-2014. Due to the small volume and expenditure shares for all other countries (Tables 6 through 10), only the U.S. NAFTA partners were analyzed. For the same reason, the five fresh-market tomatoes (greenhouse, Roma, grape, cherry, and other) reported in the USITC Interactive Tariff and Trade DataWeb were combined into three categories from Mexico (greenhouse, Roma, and other), two categories from Canada (greenhouse and other), and two categories from the rest of the world (greenhouse and other).

Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060,

702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045,

702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030,

702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS

commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099,

702006090, 702006095, 702006099). Imports were converted from kilograms to metric tons.

Table 11 summaries the resulting U.S. import volume, value, and expenditure shares for the

period 1999-2014.

Results

The full SDAIDS model was estimated for the fresh-market tomatoes reported in Table 11 using

an iterated seemingly unrelated regression (ITSUR) procedure in SAS version 9.3. The

theoretical neoclassical restrictions, equations (2) through (4), were incorporated in estimation of

the model, equation (1). The expenditure shares for these seven fresh-market tomato categories

are depicted in Figure 6 and summarized in Table 11. At ITSUR iteration 282 the convergence

criterion of 0.00001 was met. Table 12 reports the SDAIS model parameter estimates as well as

some goodness of fit measures.

Of the forty one parameter estimated (α_{i_h}, $i_h = 1, \ldots, 7$; $\gamma_{1_h j_m}$, $j_h = 1, \ldots, 7$; $\gamma_{2_h j_m}$, $j_h = 2, \ldots,$

7; $\gamma_{3_h j_m}$, $j = 3, \ldots, 7$; $\gamma_{4_h j_m}$, $j = 4, \ldots, 7$; $\gamma_{5_h j_m}$, $j = 5, \ldots, 7$; $\gamma_{6_h j_m}$, $j = 6, 7$; $\gamma_{7_h j_m}$, $j = 7$; and β_{i_h}, $i = 1,$

$\ldots, 6$), sixteen were significant at the 5% probability level, three at the 10% probability level,

five at the 20% probability level, and twenty sever were not significant (Table 12). In terms of

goodness of fit, the SDAIDS model explained more than 80% of the total variation in the

expenditure shares for four fresh-market tomatoes (other tomatoes from Mexico, greenhouse

tomatoes from Mexico, Roma tomatoes from Mexico, and greenhouse tomatoes from the rest of

the world) and it explained less than 65% for the two fresh-market tomatoes from Canada (Table 12, bottom section).

Tables 13 and 14 report the Marshallian (uncompensated) and Hicksian (compensated) price elasticities. All Marshallian own-price elasticities (Table 13) have the expected negative sign, except for the own-price elasticity of other tomatoes from the rest of the world ($\hat{e}_{7_3 7_3}$). Excluding the latter elasticity, the own-price elasticities range from -1.7008 ($\hat{e}_{2_1 2_1}$) to -0.0003 ($\hat{e}_{6_3 6_3}$). Compared to Lopez and Davis (2015) and Lopez and Peckham (2016), these own-price elasticity estimates are less elastic, which reflects the reliance of fresh-market tomato imports to meet the U.S. increasing demand. In the case of the Hicksian own-price elasticities (Table 14), all have the expected negative sign, except for the own-price elasticity of greenhouse tomatoes from Canada ($\hat{e}^c_{4_2 4_2}$) and the own-price elasticity of the other tomatoes from the rest of the world ($\hat{e}^c_{7_3 7_3}$). Own-price elasticities measure how U.S. fresh-market tomato importers respond to a 1% change in the own-price of fresh-market tomatoes, ceteris paribus. For example, 1% increase in the import price of greenhouse tomatoes from Mexico decreases the quantity imported of greenhouse tomatoes by 0.98%, ceteris paribus (Table 14). Similarly, a 1% increase in the import price of Roma tomatoes from Mexico decreases the quantity imported of Roma tomatoes from Mexico by 0.02% (Table 14). Similar to the Marshallian own-price elasticity estimates, our Hicksian own-price elasticity estimates are generally less elastic than previous studies (Lopez and Davis, 2015; Lopez and Peckham, 2016).

Excluding the own-price elasticities, there are more positive cross-price elasticities than there are negative (24 positive Marshallian cross-price elasticities, 18 negative Marshallian cross-price elasticities, 27 positive Hicksian cross-price elasticities, and 15 negative Hicksian cross-price elasticities). Positive cross-price elasticities suggest cases of supplementary types of

fresh-market tomatoes while negative cross-price elasticities suggest cases of complement types of fresh-market tomatoes, which in this study may be either from the same source of origin or from different sources of origin. For example, other tomatoes and Roma tomatoes are (gross and net) complements when imported from Mexico. If the import price of other tomatoes from Mexico increases by 1%, the quantity imported of Roma tomatoes from Mexico decreases by 0.11% (Table 14). Similarly, other tomatoes and greenhouse tomatoes are (gross and net) complements when imported from Canada and the rest of the world, but they are not (gross and net) complements when imported from Mexico. If the import price of other tomatoes from Mexico increases by 1%, the quantity imported of greenhouse tomatoes decreases by 0.13% if coming from Canada and by 0.04% if coming from the rest of the world but it will increase by 0.56% if coming from Mexico (Table 14). On the other hand, greenhouse tomatoes and other tomatoes from Mexico, Canada, or the rest of the world, are examples of (gross and net) complements. If the price of greenhouse tomatoes from the rest of the world increases by 1%, other tomatoes from Mexico, Canada and the rest of the world will increase by 6.30%, 1.18%, and 0.47% respectively (Table 14). More positive than negative cross-price elasticities seems to suggest that source of origin is not an intrinsic quality attribute for U.S. fresh-market tomato importers.

The Marhallian and Hicksian cross-price elasticity of greenhouse tomatoes from the rest of the world and other tomatoes from Mexico ($\hat{e}_{6_36_1}$ and $\hat{e}^c_{6_36_1}$) as well as greenhouse tomatoes from the rest of the world and greenhouse tomatoes from Mexico ($\hat{e}_{6_32_1}$ and $\hat{e}^c_{6_32_1}$) had relatively larger values than all other cross-price elasticity coefficients. However, relatively large coefficients are not unusual in disaggregated demand studies (Lopez et al., 2012; Chidmi and Lopez, 2007; Nevo, 2001). It suggests that the quantity imported of other tomatoes from Mexico

and the quantity imported of greenhouse tomatoes from Mexico are very responsive to the price

of greenhouse tomatoes from the rest of the world.

Table 15 reports the expenditure elasticities. Four expenditure elasticity estimates have a

positive sign $(\hat{e}_{1_1}, \hat{e}_{2_1}, \hat{e}_{3_1}, \hat{e}_{4_2})$ while three elasticity estimates have a negative sign

$(\hat{e}_{5_2}, \hat{e}_{6_3}, \hat{e}_{7_4})$. When expenditure elasticities are greater than zero; the good is considered a

"normal good", in the sense that when U.S. expenditures on fresh-market tomatoes from abroad

increase, usually the quantity imported of a fresh-market tomato variety will increase as well.

When expenditure elasticities are less than zero; the good is considered an "inferior good", in the

sense that if U.S. expenditures on fresh-market tomatoes from abroad increase, the quantity

imported of the so called inferior fresh-market tomato variety will unusually decrease.

All three expenditure elasticities for fresh-market tomatoes from Mexico $(\hat{e}_{1_1}, \hat{e}_{2_1}, \hat{e}_{3_1})$

obtained the expected positive sign (Table 15, top section). This means that if U.S. expenditures

on all imported tomatoes increase by 1%, the quantity imported of other tomatoes from Mexico,

greenhouse tomatoes from Mexico, and Roma tomatoes from Mexico increase by 0.01%, 2.84%,

and 0.68% respectively. These disaggregated expenditure elasticities estimates are similar to

previous findings at the disaggregated level. For example, in Lopez and Davis (2015), the fresh-

market tomato expenditure elasticity estimates ranged from 0.0540 to 2.4421, while our

expenditure elasticities estimates for fresh-market tomatoes from Mexico (Table 15, top section)

range from 0.0104 to 2.8435.

In the case of fresh-market tomatoes coming from Canada, if U.S. expenditures on all

imported tomatoes increase by 1%, the quantity imported of greenhouse tomatoes from Canada

is also expected to increase by 0.87%, but the quantity imported from other tomatoes from

Canada is expected to decrease by 0.32% (Table 15). Similarly, if U.S. expenditures on all

imported tomatoes increase by 1%, the quantity imported of fresh-market tomatoes from the rest of the world is expected to decrease. The negative expenditure elasticities for Canada and the rest of the world may be the result of the predominantly and rapidly increasing trend of imported greenhouse tomatoes, Roma tomatoes, and grapes tomatoes from Mexico (Tables 6, 7, and 8). In addition, it seems that negative expenditure elasticities are not unusual in disaggregated demand studies (e.g., Lopez and Peckham, 2016).

In addition, among the expenditure elasticities from Mexico, note that the expenditure elasticity for greenhouse tomatoes from Mexico $(\hat{e}_{2_1})$ has the largest magnitude while the expenditure elasticity for other tomatoes from Mexico $(\hat{e}_{1_1})$ has the lowest magnitude. This means that the U.S. consumers' demand for fresh-market greenhouse tomatoes from Mexico is very responsive to changes in U.S. expenditures on all fresh-market tomatoes while the consumers' demand for other tomatoes from the rest of the world is very irresponsive.

In summary, this study contributes to the existing literature by reporting and discussing U.S. import elasticity estimates at level of disaggregation which are currently not available. In addition, a better understanding of emerging consumption trends as well as the substitution patterns among imported fresh-market tomatoes will be beneficial to U.S. importers and growers.

Conclusion

Although U.S. fresh-market tomato production is decreasing, consumption of U.S. fresh-market tomatoes keeps increasing. This means the international market is essential for meeting U.S. consumers' demand for fresh tomatoes. In fact, U.S. imports of fresh-market tomatoes account for about 50% of the domestic consumption in volume terms, with Mexico and Canada being the two main sources.

This study employs a source differentiated almost ideal demand system (SDAIDS) to estimate the U.S. import demand for Canadian and Mexican fresh-market tomatoes. The study not only analyzes five disaggregated fresh-market tomato varieties (greenhouse, Roma, grape, cherry and other) but also considers the principal supply sources. The study estimates source-differentiated Marshallian and Hicksian price as well as expenditure elasticities. The study may assist U.S. importers and growers in better understanding imported fresh-market tomatoes.

All Marshallian and Hicksian own-price elasticity estimates obtained the anticipated negative sign, except for the Marshallian own-price elasticity of other tomatoes from the rest of the world, the Hicksian own-price elasticity of greenhouse tomatoes from Canada, and Hicksian own-price elasticity of the other tomatoes from the rest of the world. These unexpected positive signs may be the result of combining small-share tomato varieties into the other tomato category. For example, due to small volume and budget shares, this study combines Roma tomatoes, grape tomatoes, cherry tomatoes, and other tomatoes from the rest of the world into one category, other tomatoes from the rest of the world.

Excluding the own-price elasticities, there were more positive cross-price elasticities (cases substitute goods) than negatives (cases of complement goods), which seems to suggest that source of origin is not an intrinsic quality attribute for U.S. fresh-market tomato importers. The study discusses cases of substitute and complement goods from either the same source of origin or from different sources. Other tomatoes and Roma tomatoes were found to be (gross and net) complements when imported from Mexico. Similarly, other tomatoes and greenhouse tomatoes were found to be (gross and net) complements when imported from Canada and the rest of the world, but they were not (gross and net) complements when imported from Mexico. Greenhouse tomatoes and other tomatoes from Mexico, Canada, or the rest of the world, were

found to be (gross and net) complements. Four of the seven expenditure elasticity estimates had the anticipated positive sign, suggesting cases of normal goods. The remaining three expenditure elasticities were found to be inferior goods. These negative expenditure elasticities for Canada and the rest of the world may be the result of the predominantly and rapidly increasing trend of imported greenhouse tomatoes, Roma tomatoes, and grapes tomatoes from Mexico.

In conclusion, the elasticity estimates reported in this study could be useful to decision makers in establishing U.S. fresh-tomatoes import taxes and price floors, and may also assist growers in monitoring imports and implementing relevant marketing strategies. The elasticity estimates can also be used to project likely import scenarios among our NAFTA partners.

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Tables

Table 1. Fresh-market Tomatoes: U.S. Production, Exports, Imports, Apparent Consumption, Apparent Per-capita Consumption, and Ratio of Imports to Consumption, 2005-2014.

Year	Production [a]	Exports [b]	Imports [b]	Apparent Consumption	Apparent Per-Capita Consumption	Ratio Imp. to Consum.
					Quantity (kg/person)	(%)
		Quantity (metric tons)				
2005	1,789,968	147,951	951,786	2,593,803	8.70	37
2006	1,645,363	144,184	992,339	2,493,519	8.29	40
2007	1,525,297	160,777	1,070,808	2,435,327	8.02	44
2008	1,412,352	170,132	1,116,335	2,358,556	7.69	47
2009	1,507,516	170,380	1,189,601	2,526,738	8.16	47
2010	1,268,291	120,752	1,532,489	2,680,028	8.58	57
2011	1,379,195	114,564	1,491,014	2,755,645	8.75	54
2012	1,299,997	117,329	1,532,162	2,714,831	8.55	56
2013	1,197,077	109,468	1,537,472	2,625,081	8.20	59
2014	1,237,401	112,830	1,550,475	2,675,047	8.29	58
					Value ($/person)	(%)
		Value (1,000 $)				
2005	1,637,394	166,131	1,075,119	2,546,381	8.54	42
2006	1,584,708	172,625	1,233,408	2,645,491	8.79	47
2007	1,168,693	191,866	1,220,498	2,197,325	7.23	56
2008	1,414,131	210,032	1,431,589	2,635,689	8.59	54
2009	1,344,217	212,122	1,403,583	2,535,677	8.19	55
2010	1,352,315	196,873	1,798,238	2,953,680	9.46	61
2011	1,291,875	184,930	2,137,870	3,244,815	10.30	66
2012	874,195	152,349	1,867,605	2,589,450	8.16	72
2013	1,177,592	156,275	1,979,770	3,001,087	9.38	66
2014	1,134,616	166,114	1,960,938	2,929,440	9.08	67

[a] From 2005 to 2010, cherry, grape, tomatillo, and greenhouse tomatoes are excluded.
[b] Data are for fresh or chilled tomatoes (Harmonized Tariff Schedule (HTS) subheadings 07020020, 07020040, and 07020060) on a fresh-weight basis.

Sources: Production data were compiled by author from official statistics of the US. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Vegetables 2014 Summary: January 2015, Vegetables 2011 Summary: January 2012, Vegetables 2008 Summary: January 2009, Vegetables 2005 Summary: January 2006, Vegetables 2002 Summary: January 2003, and Vegetables 1999 Summary: January 2000. Exports and imports data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC). Population retrieved by author from International Monetary Fund, International Financial Statistics.

Notes: Production data were converted from pounds to metric tons using a factor of 2,204.62 pounds per metric ton. Production data are raw product intended for fresh-market sales only. Exports and imports were converted from kilograms to metric tons. Apparent consumption was computed by author and it equals production minus exports plus imports.

Table 2. Fresh Market Tomatoes: U.S. Area Planted, Area Harvested, Production, and Yield, 2005-2014.

Year	Area planted (acres) [a]	Area harvested (acres) [a]	Production (mt) [a]	Yield (mt/acre) [a]
2005	136,000	129,800	1,789,968	13.79
2006	125,300	120,200	1,645,363	13.69
2007	116,400	108,100	1,525,297	14.11
2008	109,200	105,250	1,412,352	13.42
2009	113,200	108,700	1,507,516	13.87
2010	107,700	103,000	1,268,291	12.31
2011	105,400	99,710	1,379,195	13.83
2012	104,500	101,000	1,299,997	12.87
2013	103,400	99,600	1,197,077	12.02
2014	101,800	97,600	1,237,401	12.68

[a] From 2003 to 2010, cherry, grape, tomatillo, and greenhouse tomatoes are excluded.

Source: Area planted, area harvested, and production data were compiled by author from official statistics of the US. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Vegetables 2014 Summary: January 2015, Vegetables 2011 Summary: January 2012, Vegetables 2008 Summary: January 2009, Vegetables 2005 Summary: January 2006, Vegetables 2002 Summary: January 2003, and Vegetables 1999 Summary: January 2000.

Note: Production data are raw product intended for fresh-market sales only. Production data are converted from pounds to metric tons using a factor of 2,204.62 pounds per metric ton. Yield data was computed by author and it equals production divided by area harvested.

Table 3. All Fresh-Market Tomatoes: U.S. Exports of Domestic Merchandise, by Principal Markets, 2005-2014.

Market	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Canada	130,501	119,177	121,562	124,184	110,358	87,610	89,197	89,822	89,326	94,830	105,657
Mexico	13,591	19,691	34,827	43,746	57,722	29,007	23,272	22,363	15,368	14,200	27,379
Japan	1,713	3,769	2,911	392	491	1,229	45	987	1,582	693	1,381
Bahamas	887	958	760	755	703	873	688	839	787	1,103	835
Trin & Tobago	209	100	153	204	210	586	454	950	1,358	914	514
China	0	0	0	4	5	0	0	1,187	185	514	190
Korea	113	132	53	101	114	90	0	65	356	56	108
Bermuda	86	106	85	112	119	116	107	57	68	13	87
Barbados	87	39	57	129	46	96	58	60	36	97	71
Hong Kong	0	17	20	0	1	94	165	183	142	30	65
All other	765	195	350	504	611	1,051	580	815	260	381	551
Total	147,951	144,184	160,777	170,132	170,380	120,752	114,564	117,329	109,468	112,830	136,837
					Value (1,000 $)						
Canada	149,806	144,496	150,840	157,239	139,371	117,453	132,728	113,044	121,731	125,563	135,227
Mexico	7,758	20,928	34,614	49,353	68,669	72,046	48,924	31,986	26,615	33,333	39,423
Japan	5,177	4,860	3,945	469	897	2,704	94	1,227	2,549	1,608	2,353
Bahamas	1,171	1,300	1,230	1,275	1,145	1,401	1,148	1,369	1,561	2,275	1,388
Trin & Tobago	232	79	141	210	266	733	617	1,193	1,909	1,324	670
China	0	0	0	5	14	0	0	1,684	314	713	273
Bermuda	172	246	213	271	248	274	276	110	106	18	193
Korea	83	172	88	96	166	156	0	99	800	55	172
Cayman Is	0	21	0	79	462	325	105	94	131	149	137
Turks & Caic Is	95	71	56	187	124	301	157	70	85	191	134
All other	1,638	452	739	847	759	1,479	881	1,474	473	885	963
Total	166,131	172,625	191,866	210,032	212,122	196,873	184,930	152,349	156,275	166,114	180,932

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled tomatoes (Harmonized Tariff Schedule (HTS) subheadings 07020020, 07020040, and 07020060) on a fresh-weight basis. Exports were converted from kilograms to metric tons.

Table 4. All Fresh-Market Tomatoes: U.S. Imports for Consumption, by Principal Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	801,408	844,343	949,486	987,914	1,046,869	1,380,111	1,327,309	1,379,519	1,381,306	1,389,334	1,148,760
Canada	141,642	135,141	111,723	119,385	130,310	142,590	141,349	139,311	140,240	146,534	134,823
Guatemala	0	4	252	1,155	2,762	5,408	17,351	8,937	12,088	10,308	5,827
EU-28											
Netherlands	6,249	6,148	5,171	3,445	5,308	863	308	351	339	254	2,844
Spain	275	2,141	480	1,035	93	0	0	0	0	8	403
Belgium	871	1,240	554	198	367	69	0	0	0	0	330
All other	23	294	19	6	0	34	1	0	0	5	38
Subtotal	7,419	9,823	6,224	4,684	5,768	965	309	351	339	268	3,615
Dominic Rep	857	2,422	2,650	2,853	2,862	2,172	4,162	3,224	3,202	3,924	2,833
Israel	348	570	241	221	195	360	104	369	0	37	244
All other	112	36	232	125	836	883	431	451	295	70	347
Total	951,786	992,339	1,070,808	1,116,335	1,189,601	1,532,489	1,491,014	1,532,162	1,537,472	1,550,475	1,296,448
					Value (1,000 $)						
Mexico	781,234	918,755	960,047	1,142,868	1,125,527	1,487,411	1,807,703	1,578,591	1,637,535	1,656,406	1,309,608
Canada	271,977	284,206	238,148	269,236	255,521	293,775	299,936	268,634	320,075	283,052	278,456
Guatemala	0	5	283	1,502	3,981	7,385	21,962	12,135	15,840	14,221	7,731
EU-28											
Netherlands	16,229	17,796	15,028	10,991	12,500	3,400	2,044	2,336	2,416	1,762	8,450
Spain	820	4,810	1,474	2,423	196	0	0	0	0	21	974
Belgium	2,167	2,652	1,110	534	672	312	0	0	0	0	745
All other	30	188	25	8	0	43	4	0	0	8	31
Subtotal	19,245	25,446	17,637	13,957	13,367	3,755	2,048	2,336	2,416	1,791	10,200
Dominic Rep	1,216	3,284	3,217	2,942	2,879	2,942	5,550	4,597	3,518	5,124	3,527
Israel	1,251	1,653	873	836	570	957	275	776	0	148	734
All other	195	60	294	248	1,737	2,013	396	536	386	195	606
Total	1,075,119	1,233,408	1,220,498	1,431,589	1,403,583	1,798,238	2,137,870	1,867,605	1,979,770	1,960,938	1,610,862

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled tomatoes (Harmonized Tariff Schedule (HTS) subheadings 07020020, 07020040, and 07020060) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 5. Fresh-Market Tomatoes: U.S. Imports for Consumption, by Type, 2005-2014.

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Greenhouse	293,359	321,332	368,854	419,948	484,907	580,620	667,385	728,052	771,214	882,951	551,862
Roma	358,635	373,148	424,610	420,604	439,697	612,022	546,600	555,581	533,014	470,016	473,393
Other	232,790	231,044	205,983	196,937	192,456	251,669	197,758	165,839	146,736	111,036	193,225
Grape	35,518	35,083	43,406	54,286	50,670	70,073	57,801	66,961	63,472	67,177	54,445
Cherry	31,484	31,732	27,955	24,561	21,871	18,104	21,471	15,729	23,035	19,295	23,524
Total	951,786	992,339	1,070,808	1,116,335	1,189,601	1,532,489	1,491,014	1,532,162	1,537,472	1,550,475	1,296,448
					Value (1,000 $)						
Greenhouse	476,816	552,384	639,473	715,493	760,105	979,239	1,233,718	1,216,202	1,275,758	1,318,654	916,784
Roma	301,087	331,650	302,140	372,784	354,880	454,652	556,985	417,347	427,487	379,051	389,806
Other	192,129	238,833	165,555	225,919	181,058	226,023	228,201	131,861	162,207	137,154	188,894
Grape	52,438	51,097	65,390	77,802	72,179	107,245	82,664	79,796	79,594	96,021	76,422
Cherry	52,650	59,444	47,939	39,592	35,362	31,079	36,302	22,399	34,723	30,057	38,955
Total	1,075,119	1,233,408	1,220,498	1,431,589	1,403,583	1,798,238	2,137,870	1,867,605	1,979,770	1,960,938	1,610,862

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: All data are on a fresh-weight basis. Data for fresh or chilled greenhouse tomatoes include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Data for fresh or chilled Roma or other Roma tomatoes include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Data for fresh or chilled grape tomatoes include HTS commodities 702002045, 702004045, 702004046, and 702006045. Data for fresh or chilled cherry or other cherry tomatoes include HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035. Data for fresh or chilled tomatoes or other tomatoes include HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099. Imports were converted from kilograms to metric tons.

Table 6. Fresh-Market Greenhouse Tomatoes: U.S. Imports for Consumption, by Principal Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	149,505	177,184	249,759	299,045	353,789	438,611	520,104	586,782	632,664	738,007	414,545
Canada	137,013	134,355	111,418	114,737	123,134	138,123	135,808	131,649	126,428	133,691	128,636
Guatemala	0	0	95	35	87	729	8,345	6,790	9,625	8,690	3,440
EU-28											
Netherlands	5,468	5,391	4,841	3,266	5,094	752	308	327	339	254	2,604
Spain	275	2,043	480	981	93	0	0	0	0	8	388
Belgium	704	1,103	549	198	367	69	0	0	0	0	299
All other	1	41	0	0	0	34	0	0	0	0	8
Subtotal	6,449	8,577	5,869	4,446	5,554	854	308	327	339	263	3,299
Dominic Rep	130	982	1,528	1,542	1,787	1,456	2,505	1,748	1,914	2,227	1,582
All other	262	234	185	143	556	847	315	755	244	72	361
Total	293,359	321,332	368,854	419,948	484,907	580,620	667,385	728,052	771,214	882,951	551,862
					Value (1,000 $)						
Mexico	194,730	244,021	382,330	437,986	496,549	679,687	924,111	940,729	958,414	1,035,204	629,376
Canada	264,018	283,398	237,914	262,258	247,108	290,548	293,133	259,788	299,429	266,383	270,397
Guatemala	0	0	111	41	108	900	10,360	9,299	12,777	12,136	4,573
EU-28											
Netherlands	14,471	15,721	13,956	10,305	11,885	3,071	2,040	2,150	2,416	1,762	7,778
Spain	820	4,538	1,474	2,330	196	0	0	0	0	21	938
Belgium	1,589	2,285	1,091	534	672	312	0	0	0	0	648
All other	4	23	0	0	0	43	0	0	0	0	7
Subtotal	16,885	22,568	16,521	13,169	12,752	3,426	2,040	2,150	2,416	1,784	9,371
Dominican Rep	130	1,471	1,870	1,453	1,986	2,401	3,704	3,015	2,413	2,902	2,134
All other	1,054	927	727	586	1,603	2,277	370	1,221	309	246	932
Total	476,816	552,384	639,473	715,493	760,105	979,239	1,233,718	1,216,202	1,275,758	1,318,654	916,784

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled greenhouse tomatoes (Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 7. Fresh-Market Roma Tomatoes: U.S. Imports for Consumption, by Principals Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	358,110	372,515	424,412	419,705	438,165	610,182	544,796	550,986	530,598	466,896	471,636
Canada	158	326	70	755	1,462	1,688	1,570	4,224	2,143	2,428	1,482
Dominican Rep	241	300	124	111	68	0	160	102	155	273	153
Guatemala	0	0	0	30	0	11	73	265	118	420	92
All other	127	8	4	3	3	141	0	5	0	0	29
Total	358,635	373,148	424,610	420,604	439,697	612,022	546,600	555,581	533,014	470,016	473,393
					Value (1,000 $)						
Mexico	300,307	330,981	301,952	371,779	352,736	453,151	555,324	411,782	424,836	376,516	387,936
Canada	115	296	41	814	2,034	1,304	1,265	4,772	2,360	2,081	1,508
Dominican Rep	321	342	120	145	98	0	238	224	43	132	166
Guatemala	0	0	0	34	0	16	158	555	248	321	133
All other	344	31	28	10	12	182	0	14	0	0	62
Total	301,087	331,650	302,140	372,784	354,880	454,652	556,985	417,347	427,487	379,051	389,806

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled Roma or other Roma tomatoes (Harmonized Tariff Schedule (HTS) commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 8. Fresh-Market Grape Tomatoes: U.S. Imports for Consumption, by Principal Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	35,467	34,940	43,077	53,341	49,793	69,470	56,575	65,712	62,452	65,914	53,674
Dominican Rep	29	140	329	890	837	588	946	1,159	862	1,011	679
Canada	21	0	0	48	21	3	203	91	146	216	75
All other	0	3	0	7	19	13	77	0	13	36	17
Total	35,518	35,083	43,406	54,286	50,670	70,073	57,801	66,961	63,472	67,177	54,445
					Values (1,000 $)						
Mexico	52,333	50,961	65,083	76,768	71,401	106,869	81,517	78,813	78,669	94,257	75,667
Dominican Rep	57	124	307	917	654	358	664	760	538	1,355	573
Canada	47	0	0	86	40	2	405	223	365	370	154
All other	0	12	0	31	84	16	78	0	22	40	28
Total	52,438	51,097	65,390	77,802	72,179	107,245	82,664	79,796	79,594	96,021	76,422

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled grape tomatoes (Harmonized Tariff Schedule (HTS) commodities 702002045, 702004045, 702004046, and 702006045) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 9. Fresh-Market Cherry Tomatoes: U.S. Imports for Consumption, by Principal Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	31,244	31,119	27,349	24,416	21,485	18,006	21,108	15,139	15,225	13,891	21,898
Canada	0	0	0	17	339	0	160	381	7,639	5,155	1,369
Dominican Rep	104	207	535	17	11	0	72	75	167	241	143
All other	137	407	71	111	36	98	131	134	5	8	114
Total	31,484	31,732	27,955	24,561	21,871	18,104	21,471	15,729	23,035	19,295	23,524
					Value (1,000 $)						
Mexico	52,058	58,074	46,998	39,174	34,791	30,839	35,538	21,158	21,493	21,099	36,122
Canada	0	0	0	42	462	0	339	680	12,795	8,432	2,275
Dominican Rep	262	452	740	26	12	0	224	248	426	508	290
All other	330	918	201	351	97	240	202	313	9	17	268
Total	52,650	59,444	47,939	39,592	35,362	31,079	36,302	22,399	34,723	30,057	38,955

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled cherry or other cherry tomatoes (Harmonized Tariff Schedule (HTS) commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 10. Other Fresh-Market Tomatoes: U.S. Imports for Consumption, by Principals Sources, 2005-2014.

Source	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average 2005-14
					Quantity (metric tons)						
Mexico	227,081	228,585	204,889	191,407	183,637	243,842	184,727	160,900	140,367	104,626	187,006
Canada	4,450	460	235	3,828	5,354	2,776	3,609	2,966	3,885	5,045	3,261
Guatemala	0	4	157	1,090	2,675	4,655	8,752	1,759	2,328	1,159	2,258
EU-28											
Netherlands	672	666	312	132	194	110	1	24	0	0	211
All other	175	486	25	60	0	0	1	0	0	0	75
Subtotal	848	1,152	337	192	194	110	2	24	0	0	286
Dominican Rep	354	795	134	293	160	128	478	141	105	171	276
Costa Rica	36	36	214	84	357	90	16	43	52	0	93
All other	22	12	17	43	80	67	175	7	0	35	46
Total	232,790	231,044	205,983	196,937	192,456	251,669	197,758	165,839	146,736	111,036	193,225
					Value (1,000 $)						
Mexico	181,806	234,719	163,683	217,160	170,051	216,866	211,214	126,109	154,122	129,329	180,506
Canada	7,797	512	193	6,036	5,878	1,921	4,793	3,170	5,126	5,786	4,121
Guatemala	0	5	172	1,427	3,873	6,453	11,209	1,980	2,784	1,715	2,962
EU-28											
Netherlands	1,435	1,818	994	543	521	323	4	186	0	0	582
All other	552	795	44	102	0	0	4	0	0	0	150
Subtotal	1,987	2,613	1,038	645	521	323	8	186	0	0	732
Dominican Rep	447	894	180	400	129	184	720	350	99	227	363
Costa Rica	28	60	239	116	407	116	30	49	77	0	112
All other	64	31	50	133	199	161	227	16	0	97	98
Total	192,129	238,833	165,555	225,919	181,058	226,023	228,201	131,861	162,207	137,154	188,894

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: Data are for fresh or chilled tomatoes or other tomatoes (Harmonized Tariff Schedule (HTS) commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099) on a fresh-weight basis. Imports were converted from kilograms to metric tons.

Table 11. Average Quantity, Value, and Expenditure Shares of Fresh-Market Tomato Imports from Mexico and Canada, 1999-2014.

Fresh-Market Tomato	Quantity (metric tons)	Value ($)	Expenditure Share
MEXICO			
Other Tomatoes	321,893	309,680,762	0.2544
Greenhouse Tomatoes	231,773	349,466,942	0.2871
Roma Tomatoes	380,028	299,283,041	0.2459
CANADA			
Greenhouse Tomatoes	88,418	179,483,050	0.1474
Other Tomatoes	23,165	35,781,981	0.0294
ROW			
Greenhouse Tomatoes	9,935	19,701,436	0.0162
Other Tomatoes	13,900	23,927,030	0.0197

Note: Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).

Table 12. U.S. Fresh-Market Tomato Imports: SDAIS Model Parameter Estimates, 1999-2014.

| | MEXICO | | | | | | CANADA | | | | ROW | | | |
| | Other Tomato | | Greenhouse | | Roma Tomato | | Greenhouse | | Other Tomato | | Greenhouse | | Other Tomato | |
Par.	Est.	Std Err	Est.	Std Err	Est.	Std Err	Est.	Std Err	Est.	Std Err	Est.	Std Err	Est.	Std Err
α_{i_h}	3.2187*	0.6111	-5.1476*	0.9840	1.2417*	0.2755	0.3736	0.4897	0.5571†	0.3218	0.5377*	0.1546	0.2187	0.2302
$\gamma_{i_h^1k}$	-0.7365‡	0.3354	1.6377*	0.5318	-0.3612*	0.1092	-0.1412	0.1663	-0.1805†	0.1278	-0.1699*	0.0575	-0.0484	0.0849
$\gamma_{i_h^2k}$	1.6377*	0.5318	-2.9155*	0.8877	0.4371*	0.1930	0.0257	0.2847	0.3398†	0.2082	0.3383*	0.1037	0.1369	0.1400
$\gamma_{i_h^3k}$	-0.3612*	0.1092	0.4371*	0.1930	0.0988‡	0.0462	0.0682	0.0515	-0.1045*	0.0311	-0.0797*	0.0249	-0.0587‡	0.0266
$\gamma_{i_h^4k}$	-0.1412	0.1663	0.0257	0.2847	0.0682	0.0515	0.1382†	0.0798	-0.0544	0.0557	0.0126	0.0353	-0.0492	0.0426
$\gamma_{i_h^5k}$	-0.1805†	0.1278	0.3398†	0.2082	-0.1045*	0.0311	-0.0544	0.0557	0.0206	0.0599	-0.0274	0.0204	0.0063	0.0337
$\gamma_{i_h^6k}$	-0.1699*	0.0575	0.3383*	0.1037	-0.0797*	0.0249	0.0126	0.0353	-0.0274	0.0204	-0.0669*	0.0211	-0.0070	0.0165
$\gamma_{i_h^7k}$	-0.0484	0.0849	0.1369	0.1400	-0.0587‡	0.0266	-0.0492	0.0426	0.0063	0.0337	-0.0070	0.0165	0.1034	0.0406
β_{i_h}	-0.2556	0.0402	0.4685	0.0555	-0.0806*	0.0201	-0.0206	0.0432	-0.0474†	0.0283	-0.0463*	0.0111	-0.0181	n.a.

Goodness of Fit

R^2	Adj. R^2	R^2	Adj. R^2	R^2	Adj. R^2	R^2	Adj. R^2	R^2	Adj. R^2	R^2	Adj. R^2	R^2	Adj. R^2
0.8926	0.8440	0.9527	0.9314	0.6975	0.5609	0.3167	0.0082	0.6531	0.4965	0.8494	0.7814	n.a.	n.a.

Note: Significant at the 0.05, 0.10, and 0.20 probability levels are indicated by asterisks (*), double daggers (‡), and daggers (†) respectively, except for the parameter coefficient estimates whose standard errors are not available (n.a.) because they correspond to the omitted equation in the system. Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).

Table 13. U.S. Fresh-Market Tomato Imports: SDAIS Model, Marshallian Price Elasticities, 1999-2014.

	Marshallian Price Elasticities ($e_{i_h j_m}$)						
	MEXICO			CANADA		ROW	
$i_h \backslash j_m$	Other	Greenhouse	Roma	Greenhouse	Other	Greenhouse	Other
MEXICO							
Other Tomatoes	-0.3119	0.5582	-0.1125	-0.1232	-0.0529	-0.0398	0.0637
Greenhouse Tomatoes	-0.1499	-1.7008	-0.6752	-0.6873	0.1342	0.1795	0.0708
Roma Tomatoes	-0.2909	-0.1347	-0.1880	0.4097	0.6487	-1.9454	0.1762
CANADA							
Greenhouse Tomatoes	-0.4208	-0.5888	0.5915	-0.0844	0.0862	-0.5701	-0.1429
Other Tomatoes	4.1831	-6.4100	1.3133	0.3551	-0.0575	0.7200	0.3599
ROW							
Greenhouse Tomatoes	6.5625	-10.4810	2.3128	0.9145	1.2116	-0.0003	0.4855
Other Tomatoes	3.3138	-5.4386	1.0964	0.2418	3.4200	-5.2123	0.3886

Note: Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).

Table 14. U.S. Fresh-Market Tomato Imports: SDAIS Model, Hicksian Price Elasticities, 1999-2014.

	MEXICO			CANADA		ROW	
Hicksian Price Elasticities ($ec_{i_h j_m}$)							
$i_h \setminus j_m$	Other	Greenhouse	Roma	Greenhouse	Other	Greenhouse	Other
MEXICO							
Other Tomatoes	-0.3092	0.5608	-0.1099	-0.1215	-0.0525	-0.0395	0.0639
Greenhouse Tomatoes	0.5846	-0.9781	0.0375	-0.2309	0.2361	0.2446	0.1212
Roma Tomatoes	-0.1157	0.0377	-0.0179	0.5186	0.6730	-1.9299	0.1882
CANADA							
Greenhouse Tomatoes	-0.1956	-0.3673	0.8100	0.0555	0.1174	-0.5501	-0.1274
Other Tomatoes	4.0998	-6.4920	1.2326	0.3034	-0.0690	0.7127	0.3541
ROW							
Greenhouse Tomatoes	6.2985	-10.7407	2.0567	0.7504	1.1750	-0.0237	0.4675
Other Tomatoes	3.3075	-5.4448	1.0903	0.2379	3.4191	-5.2128	0.3882

Note: Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).

Table 15. U.S. Fresh-Market Tomato Imports: SDAIS Model, Expenditure Elasticities, 1999-2014.

i_h	Expenditure Elasticities (e_{i_h})
MEXICO	
Other Tomatoes	0.0104
Greenhouse Tomatoes	2.8435
Roma Tomatoes	0.6784
CANADA	
Greenhouse Tomatoes	0.8718
Other Tomatoes	-0.3224
ROW	
Greenhouse Tomatoes	-1.0218
Other Tomatoes	-0.0244

Note: Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).
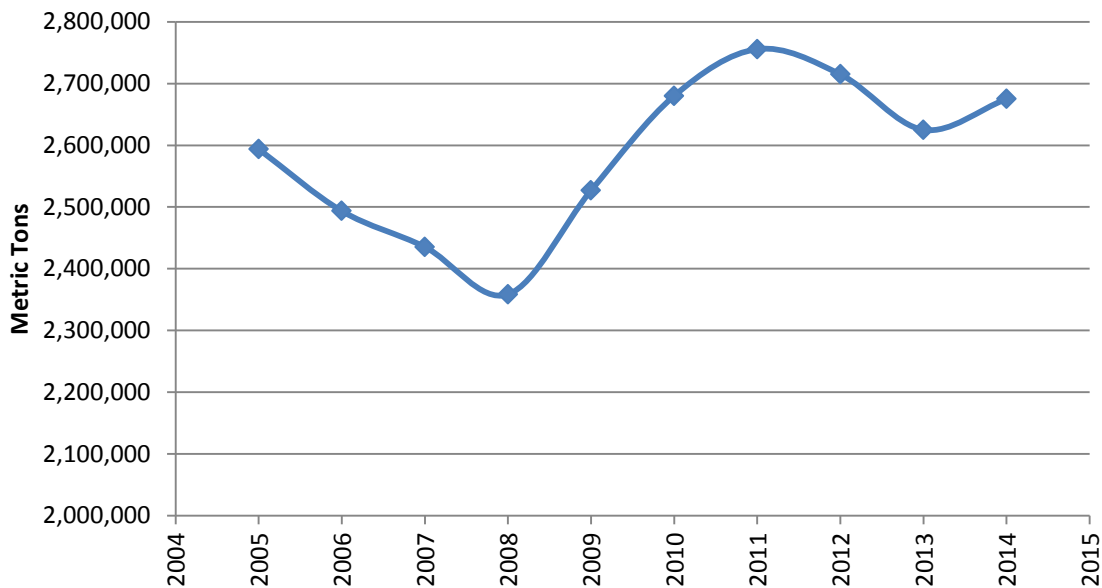
Figures

Figure 1. Fresh-Market Tomatoes: U.S. Apparent Consumption.

Note: Apparent consumption equals production minus exports plus imports. Production data were compiled by author from official statistics of the US. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Vegetables 2014 Summary: January 2015, Vegetables 2011 Summary: January 2012, Vegetables 2008 Summary: January 2009, Vegetables 2005 Summary: January 2006, Vegetables 2002 Summary: January 2003, and Vegetables 1999 Summary: January 2000. Production data were converted from pounds to metric tons using a factor of 2,204.62 pounds per metric ton. Exports and imports data were retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC). Exports and imports were converted from kilograms to metric tons.
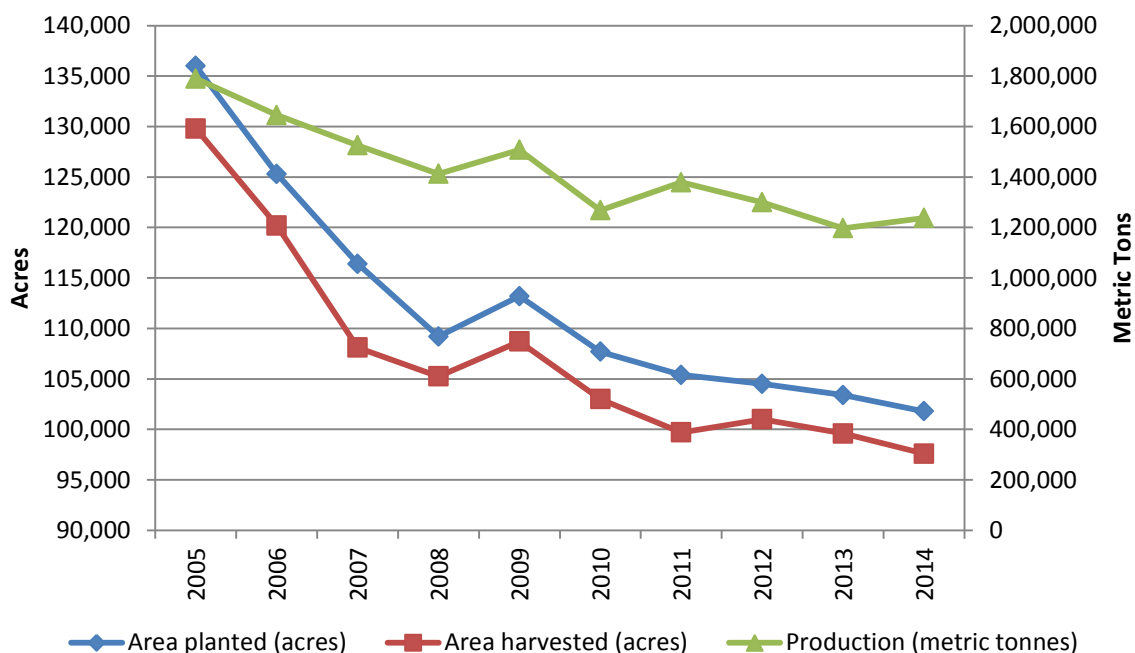
Figure 2. Fresh Market Tomatoes: U.S. Area Planted, Area Harvested, and Production, 2005-2014.

Source: Area planted, area harvested, and production data were compiled by author from official statistics of the US. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Vegetables 2014 Summary: January 2015, Vegetables 2011 Summary: January 2012, Vegetables 2008 Summary: January 2009, Vegetables 2005 Summary: January 2006, Vegetables 2002 Summary: January 2003, and Vegetables 1999 Summary: January 2000.

Note: Production data are raw product intended for fresh-market sales only. Production data are converted from pounds to metric tons using a factor of 2,204.62 pounds per metric ton.
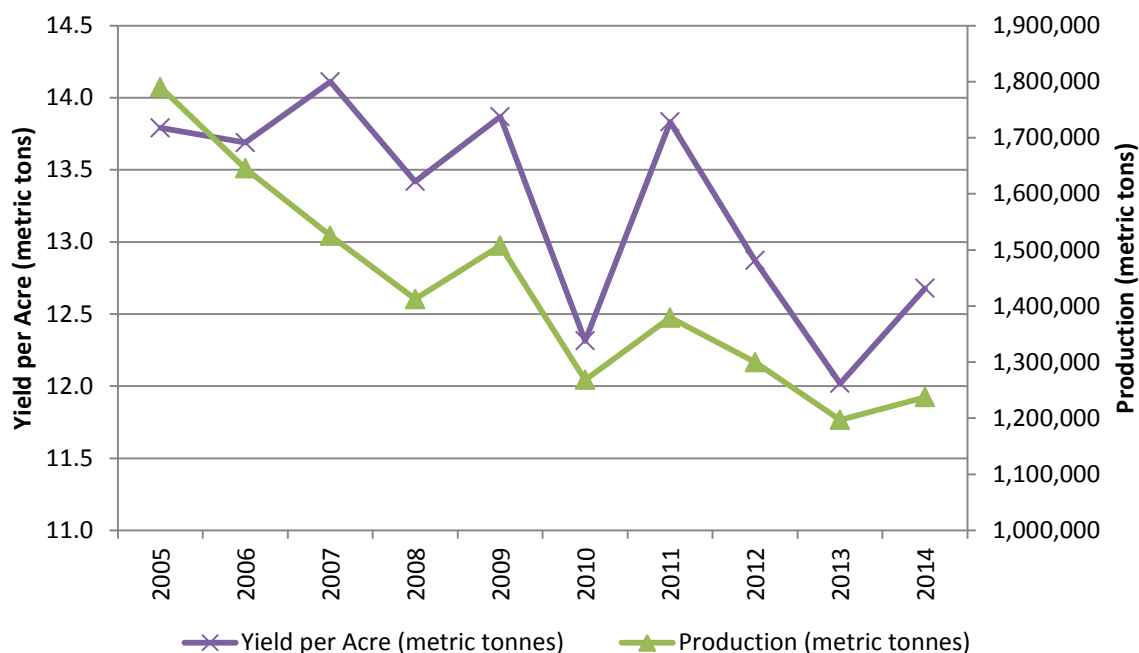
Figure 3. Fresh Market Tomatoes: U.S. Production and Yield, 2005-2014.

Source: Production and area harvested data were compiled by author from official statistics of the US. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Vegetables 2014 Summary: January 2015, Vegetables 2011 Summary: January 2012, Vegetables 2008 Summary: January 2009, Vegetables 2005 Summary: January 2006, Vegetables 2002 Summary: January 2003, and Vegetables 1999 Summary: January 2000.

Note: Production data are raw product intended for fresh-market sales only. Production data are converted from pounds to metric tons using a factor of 2,204.62 pounds per metric ton. Yield data was computed by author and it equals production divided by area harvested.
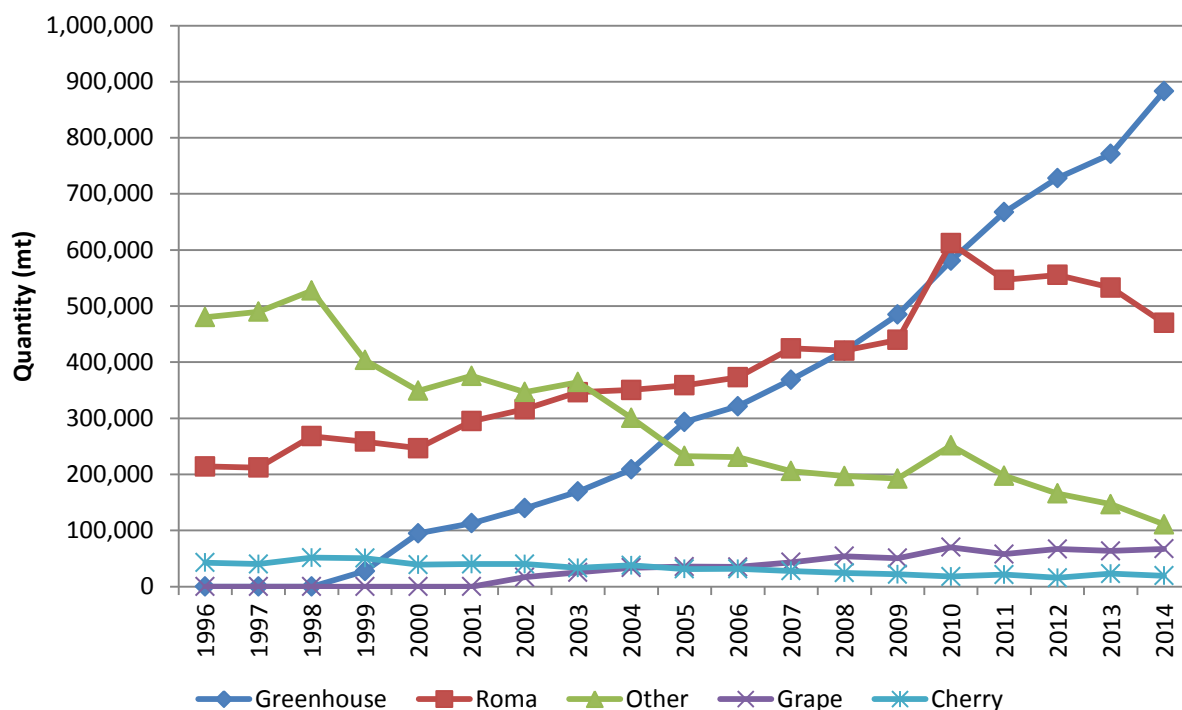
Figure 4. Fresh-Market Tomatoes: U.S. Imports (Metric Tons) for Consumption, by Type, 1996-2014.

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: All data are on a fresh-weight basis. Data for fresh or chilled greenhouse tomatoes include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Data for fresh or chilled Roma or other Roma tomatoes include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Data for fresh or chilled grape tomatoes include HTS commodities 702002045, 702004045, 702004046, and 702006045. Data for fresh or chilled cherry or other cherry tomatoes include HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035. Data for fresh or chilled tomatoes or other tomatoes include HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099. Imports were converted from kilograms to metric tons.
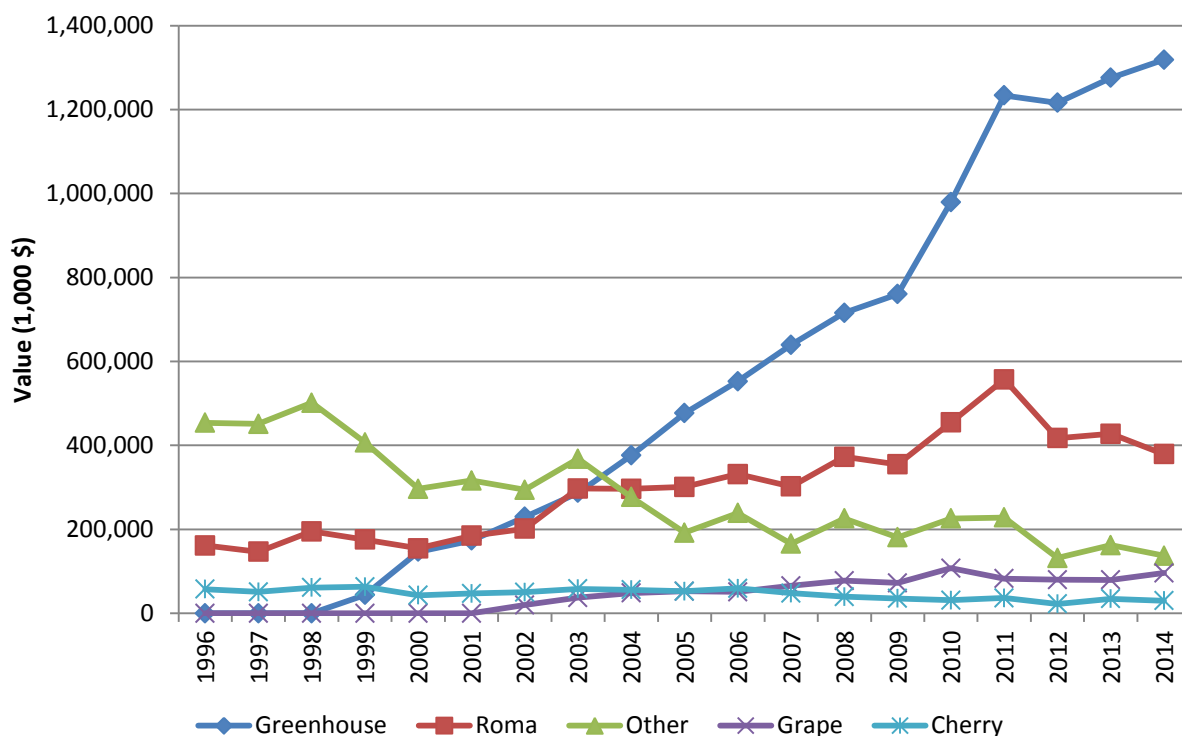
Figure 5. Fresh-Market Tomatoes: U.S. Imports ($) for Consumption, by Type, 1996-2014.

Source: Data retrieved by author from the USITC Interactive Tariff and Trade DataWeb, Version 3.1.0, of the United States International Trade Commission (USITC).

Note: All data are on a fresh-weight basis. Data for fresh or chilled greenhouse tomatoes include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Data for fresh or chilled Roma or other Roma tomatoes include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Data for fresh or chilled grape tomatoes include HTS commodities 702002045, 702004045, 702004046, and 702006045. Data for fresh or chilled cherry or other cherry tomatoes include HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035. Data for fresh or chilled tomatoes or other tomatoes include HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099. Imports were converted from kilograms to metric tons.
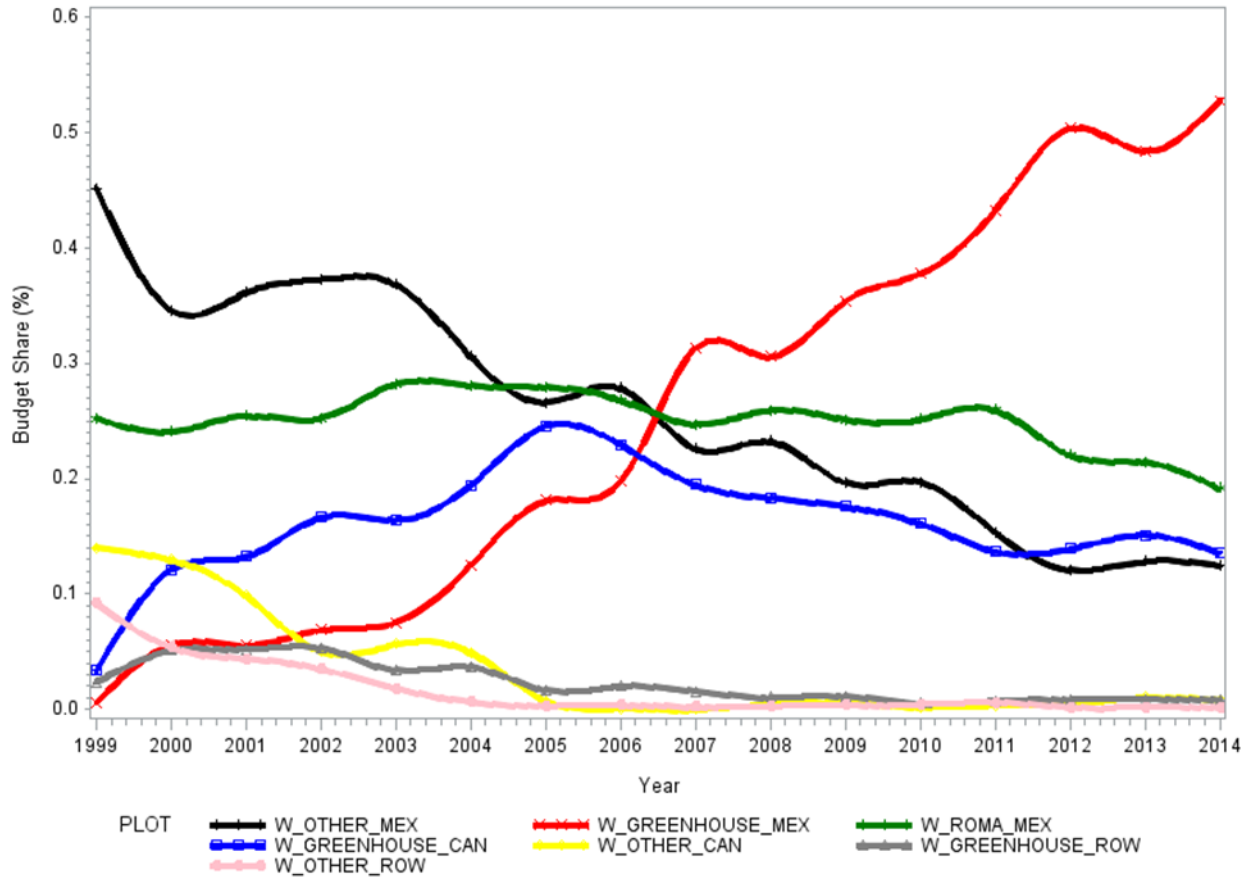
Figure 6. Expenditure Shares of Fresh-Market Tomato Imports from Mexico and Canada, 1999-2014.

Note: Greenhouse tomatoes from Mexico, Canada and the rest of the world include Harmonized Tariff Schedule (HTS) commodities 702002010, 702004010, and 702006010. Roma tomatoes from Mexico include HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065. Other tomatoes from Mexico include grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099). Other tomatoes from Canada and the rest of the world include Roma tomatoes (HTS commodities 702002060, 702002065, 702004060, 702004065, 702006060, and 702006065) grape tomatoes (HTS commodities 702002045, 702004045, 702004046, and 702006045), cherry tomatoes (HTS commodities 702002030, 702002035, 702004030, 702004035, 702006030, and 702006035), and other tomatoes (HTS commodities 702002090, 702002095, 702002099, 702004090, 702004098, 702004099, 702006090, 702006095, 702006099).