Analysis of U.S. Demand for Fresh Tropical Fruits and Vegetables Inports

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Abstract

This paper estimates a demand system for a selected tropical fresh fruit and vegetable imports in to the U.S. using a Linear Approximate Almost Ideal Demand Systems model for the period 1989-2008. Further the paper attempts to capture trade policy and seasonality effects that affect the demand for fresh fruit and vegetable imports. Results show that most of the price elasticities of demand have the expected signs and less than unity magnitude except for tomatoes. Complimentary commodities include bananas and papayas, grapes, and mangoes, peppers and tomatoes and avocados, and tomatoes and cucumber. Substitutes include pineapples and papayas, grapes and papayas, and mangoes and tomatoes. Trade policy and seasonality are also found to affect fresh fruit and vegetable imports.

Introduction

Since the 1970s, U.S. demand for fresh fruits and vegetables, especially the demand for tropical fruits and vegetables has been increasing tremendously. The growth in demand could be attributed to rising consumer incomes and an increasing consumer awareness of the health benefits of eating diets that are heavy in fresh produce over the years (Huang and Huang 2007; Pollack 2001; Wells and Buzby 2008). There is also the effect of a growing U.S. population of immigrants particularly Asians and Hispanics that is accustomed to a culture of heavy fresh produce meals.

In response to the rising demand for fresh fruits and vegetables, domestic production rose but not at the same rate as the increase in demand mainly due to the unfavorable U.S. continental climate, seasonality in production, and high domestic farm labor costs (Huang and Huang 2007; Martin and Thompson 1992; Cook 2001). As a result, the U.S. increasingly became more dependent on imports to satisfy demand (Huang and Huang 2007). Between 1990-92 and 2004-06, annual U.S. imports of fresh fruits and vegetables rose from 2.7 billion to 7.9 billion U.S. dollars. The share of total U.S. imports from agriculture for fresh fruits and vegetables increased from 11.5 percent to 13.3 percent for the same period. By the year 2003-05, imports accounted for 44 percent of fresh fruit and vegetable consumption (Huang and Huang 2007) and at the moment, the a net importer of fresh fruits.

Although the demand for all fresh fruits and vegetables imports went up in general over the last three decades, most of the growth was for tropical fresh fruits and fresh vegetables. The main tropical fresh fruit imports include bananas, mangoes/guavas, papaya, pineapples, avocadoes, and fresh grapes. Fresh tomatoes, cucumbers and

gherkins, peppers, and asparagus on the other hand dominate U.S. fresh vegetable imports. Out of these commodities, mangoes/guavas, papayas, avocadoes, fresh grapes, tomatoes, cucumbers, and peppers have recorded the highest growth in imports since early 1990. The growth of value of imports of pineapples, mangoes, guavas, papayas, and avocados was 6 times greater in 2006 compared to 1990. Import values for grapes grew by over 350 percent in 2006 compared to 100 percent in 1990. Fresh bananas, which comprise the bulk of fresh fruit imports showed no significant growth and its import value growth was stable at 100 percent for the entire period (Huang and Huang 2007). During the same period, the import volume of fresh bell peppers, tomatoes, and cucumbers and gherkins grew by over 400, 300, and 250 percent respectively (Huang and Huang 2007).

The significance of imports in U.S. consumption of tropical fresh fruits in the U.S. consumption of fresh fruits grew substantially from the year 1989 to 2006. Hundred percent of all the mangoes/guavas and banana consumed in the U.S. are imported. The import shares of fresh papayas and pineapples drastically increased from slightly less than 50 percent in 1989 to over 80 percent in 2006. Avocado imports the accounted for nearly 60 percent of U.S. domestic consumption in 2006 compared to 10 percent in 1989 (U.S. Department of Agriculture 2007).

U.S. fresh fruit and vegetable import supply is dominated by a few regions perhaps due to high transport costs, perishable nature of fresh produce commodities, and sanitary and phytosanitary (SPS) controls (U.S. Department of Agriculture 2008a; U.S. Department of Agriculture 2008b). The North American Free Trade Agreement (NAFTA) trading block is the single largest supplier of fresh vegetables to the U.S. and

accounts for 84 percent of U.S. vegetable imports (Huang and Huang 2007; U.S. Department of Agriculture 2007). The main sources of U.S. fresh fruit imports are the so-called “banana-exporting countries”, the southern hemisphere countries, and NAFTA partners. The banana exporting countries include Colombia, Costa Rica, Ecuador, Guatemala, Honduras and Panama and supply 36 percent of fresh fruit imports of which two-thirds are bananas (Huang and Huang 2007). Second to banana-exporting countries in supplying U.S. fresh fruits are the Southern Hemisphere countries, which include Argentina, Australia, Brazil, Chile, New Zealand, South Africa, and Peru. Together the Southern Hemisphere countries supply 32 percent of U.S. fresh fruit imports. The third major source of U.S. fresh fruit imports is NAFTA and it contributes approximately 27 percent of the total fresh fruit imports mostly from Mexico (Huang and Huang 2007; U.S. Department of Agriculture 2007; Cook 2001).

The entry of more trading partners such as the Dominican Republic-Central America Free Trade Agreement (CAFTA-DR), and the Chile-US Free Trade Agreement further improved the availability of imports and encouraged more consumption of exotic fresh fruits and vegetables. Other supply factors that have encouraged imports, are improved technology in shipping and storage, U.S. farm labor shortages and costs, and unfavorable U.S. continental climate (Lucier et al. 2006). As a result the U.S. is increasingly depending on importation of tropical produce from mainly tropical countries to satisfy its demand is currently a net importer of fresh produce.

The competitiveness of U.S. farm produce within the country and in the major U.S. fruit and vegetable export markets has been extensively studied (Andayani and Tilley 1997; Feleke 2006; Lee, Seale, and Jierwiriyapant 1990). However, few studies

have investigated U.S. demand for fresh fruits and vegetables import. Given the strong evidence of a rapid growth of fresh fruits and vegetables consumption and imports, it is important to understand the demand interrelationships and the seasonality effects that affect demand for these commodities.

This paper analyzes import demand relationships among selected fresh tropical fruits and vegetables in the U.S. from 1989 to 2008. The fresh tropical fruits and vegetables considered in the study include bananas, pineapples, avocadoes, papayas, mangoes and guavas for tropical fresh fruits, and peppers, tomatoes, cucumbers, and asparagus for fresh vegetables. The specific objective of the paper is to estimate and provide reliable price elasticities of demand for U.S. fresh tropical fruit and vegetable imports and to identify any seasonality trends that affect the demand for imported fresh tropical fruits and vegetables. By assessing the demand relationships among fresh tropical fruits and vegetables in the U.S., the paper offer seeks to offer some policy recommendations to supplying countries' strategies and the U.S. trade policies for fresh fruits and vegetables.

The rest of this paper is organized in sections as follows. In the next section, a brief preview of the existing literature and methods of analyses are presented. A detailed description of the data utilized in the study follows section three under methods. This is followed by a presentation of the results of the analysis and finally the conclusions.

Literature Review

Common import demand analysis approaches involve the use of consumer demand theory and production theory. The consumer demand theory approach treats imports as final products that directly enter a consumer's utility function (Schmitz and

Seale 2002) while production theory treats imports as inputs (Washington and Kilmer 2002). The consumer demand theory approach enables the derivation of traditional consumer demand and labor supply functions from utility maximization. On the other hand, input demand and output supply functions from profit maximization or cost minimization can be obtained from production theory approach.

Consumer approach application to import demand analysis is extensive. Empirical models include the Armington model (Armington 1969), AIDS model (Deaton and Muellbauer 1980) and Rotterdam model (Theil 1980). Past literature cautions against treating imports as final goods as in the past (Lee, Seale, and Jierwiriyapant 1990; Seale, Sparks, and Buxton 1992) because the nature of international trade is such that most goods are intermediate commodities which require certain processing or repackaging before they are finally distributed to the consumer (Washington and Kilmer 2002; Muhammad, Jones, and Hahn 2007). In such cases, a production approach is better placed to estimate import demand. However, in the case of fresh fruits and vegetables, imports are distributed to consumers in their fresh form and there is very little value-added process is involved. The imports can therefore be justifiably classified as final goods and the AIDS model is deemed appropriate. Following Deaton and Muellbauer (1993, 1980), the Almost Ideal Demand System (AIDS) model can be expressed as follows:

$$w_i = \alpha_i + \sum \gamma_{ij} \log p_j + \beta_i \log(y / P) + u_i \qquad (1)$$

where w_i is the expenditure share of good *i*, *y* is total expenditure, and u_i denotes the disturbance term. P is a price index defined as,

$$\log p = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{ij} \log p_i p_j \quad (2)$$

To be consistent with consumer demand theory, we must ensure that the demand system satisfies adding-up, homogeneity in prices and income and Slutsky symmetry conditions hold as follows:

$$\Sigma\alpha_k = 1, \quad \Sigma_k\gamma_{kj} = 0, \quad \text{and} \quad \Sigma_k\beta_k = 0 \quad \text{(adding-up property)} \quad (3)$$

$$\Sigma_j\gamma_{kj} = 0 \text{ : (homogeneity property), and} \quad (4)$$

$$\gamma_{kj} = \gamma_{jk} \text{ : (symmetry property)} \quad (5)$$

The intercept α_i represents the estimated budget share of commodity i when all logarithmic prices and real expenditures are zero and can be interpreted as the subsistence consumption of commodity i. The β_i's are expenditure coefficients and represent the change in commodity i's expenditure share with respect to change in real income, *ceteris paribus*. If $\beta_i > 0$, then that commodity is a luxury, and if $\beta_i < 0$, the good is a necessity. Expenditure share w_i, hence increases with an increase in total expenditure if $\beta_i > 0$ and decrease if $\beta_i < 0$. The price coefficients, γ_{ij}, represent the change in the ith budget share with respect to a percentage change in the jth price with real expenditures held constant. If $\gamma_{ij} > 0$, goods i and j are substitutes, while if $\gamma_{ij} < 0$, they are complementary goods.

To capture seasonality in the AIDS model, we apply seasonal trigonometric variables in each share equation following Arnade and Pick (1998) as follows:

$$w_i = \alpha_i + \sum \gamma_{ij} \log p_j + \beta_i \log(y/P) + na_i Nafta + \sum_{u=1}^{4} \alpha_{1iu} f_u + \sum_{v=1}^{4} \alpha_{2iv} g_v + t_i trend + \varepsilon_i \quad (6)$$

where f_u and g_u are seasonal functions defined as, $f_u = \cos((u/z)\Pi t)$, and $g_u = \sin((v/z)\Pi t)$. Here t represents the observation number while $z = s/2$ where s is the frequency of the data. Since we use quarterly data $s = 4$ and $z = 2$. u and v represent the seasonal frequencies of data and the seasonal coefficients α_{1iu} and α_{2iv} measure the contribution of each seasonal cycle to the model (Arnade and Pick 1998). Since most fresh fruit and vegetable imports portray one peak season per year (winter and spring), we set u and v equal to 1. In addition we add a trend variable $trend_i$ to capture any trend in fresh tropical fruits and vegetable imports. We also introduce a dummy variable, *Nafta* to capture the effect of the implementation of the NAFTA trade agreement in 1995 between U.S., Canada, and Mexico. *Nafta* equals 0 for the time period running from 1989 through 1994 and 1 thereafter.

Data and Results

The data set ranges from the 1st quarter of 1989 through the 3rd quarter of 2008. Quarterly import quantities and values for the selected fresh fruits and vegetables were calculated by aggregation of monthly quantities and values that were obtained from the USDA's Foreign Agricultural Statistics (FAS) website. Import values are measured are on Cost, Insurance, and Freight (CIF) basis. Using import values and quantities, per-unit values (cents/pound) for all the selected imports were calculated and used as proxies for import prices.

The AIDS demand model (6) is estimated for ten fresh fruit and vegetable imports: bananas, pineapples, papaya, mangoes/guavas, grapes, avocados, tomatoes, peppers, cucumbers, and asparagus. Estimation is done using TSP Version 5.0 (Hall and Cummins 2005) by iterated seemingly unrelated regression (ISUR) estimation. To

confirm to economic theory, homogeneity, symmetry, and adding-up conditions were imposed on the data. The equation for fresh grapes was dropped from the estimation process and its parameters are calculated from the estimated parameters. Results are presented in tables 2 and 3 in the Appendix. Table 2 presents the estimated coefficients of the LA/AIDS model. Only three intercepts, $\alpha_i's$ are statistically significance (fresh papaya, fresh mango/guava, and fresh peppers). The real expenditure parameters for bananas, avocados, tomatoes, and asparagus are positive ($\beta_i > 0$) implying that they are luxuries. While our expectations are that imported fresh fruits and vegetables are luxuries, this finding for bananas and tomatoes is surprising because they are more of stable commodities. Pineapples, papayas, mangoes, peppers, and cucumbers have $\beta_i < 0$ and hence are deemed to be necessities against our expectations.

----------Table 2 about here----------

The results show that NAFTA significantly impacted U.S. imports budget shares of fresh bananas, pineapples, papayas, avocados, tomatoes and peppers. NAFTA significantly increased fresh papayas, tomatoes and pepper import budget shares as expected due to improved availability. The entry of NAFTA resulted in the availability of a wide range of fresh fruits which led to a shift of consumer expenditure from bananas which were previously the main fresh fruit imports to new commodities such as fresh papaya and mangoes/guavas. This explains the negative sign of NAFTA dummy for bananas and pineapples. The introduction of NAFTA resulted to 5 percent reduction in the budget share for banana imports.

Further, the bananas budget share equation has a negative significant trend. This implies that budget shares for banana imports have been declining over the study period

as consumers reallocate their budget towards other fresh fruit and vegetable imports. Import budget shares for pineapples, avocados, peppers, and cucumber have a positive trend implying an increase in expenditure in line with increased growth in their import values noted in the literature (Huang and Huang 2007).

All the commodities have at least one seasonality variable that is statistically significant confirming that that seasonality in the data play a major role in the demand for tropical fresh fruits and vegetables.

The uncompensated elasticities of demand are calculated at sample means and shown in Table 3. The expenditure elasticities for imported fresh asparagus, tomatoes, avocados, and bananas are greater that one implying that they are luxury goods. While the finding is justified for imported fresh asparagus and avocados because they are exotic commodities, the same is not true for bananas and tomatoes which are considered stable foods.

----------Table 3 about here----------

The own-price elasticities of demand for all the ten fresh fruit and vegetable imports have a negative sign which conform to economic theory that they are normal goods. The own-price elasticities range from -.1202 for papaya to -1.0995 for tomatoes. However, own-price elasticities of demand are statistically significant at 0.1 significance level for bananas, mangoes/guavas, avocado, tomatoes, peppers, and cucumbers. The own-price elasticity for bananas is -.5416 implying that a one percent increase in the price of bananas will result to .54 reduction in budget share for imported bananas. The magnitude of the elasticity is comparable to -.4236 and -.4999 reported by You, Epperson

and Huang (1996) and Huang and Lin (1887). Avocados have a price elasticity of -.8823 which is near unity as expected.

Own-price elasticity for tomatoes is shown to be greater than unity which is twice the -.622 reported by Huang and Lin (1996) and -.405 by You, Epperson and Huang (1996). Price elasticities for grapes and asparagus are underestimated in comparison to You, Epperson and Huang (1996) while those of tomatoes, peppers, cucumbers have been overestimated. Others that appear to be unusually small include those for papaya and pineapples despite lack of comparison studies.

The estimated cross-price elasticities show that bananas and papayas, bananas and mangoes/guava, bananas and asparagus are compliments since their cross-price elasticities are negative and significant. Pineapples and papayas, avocado, and asparagus are substitutes owing to the positive cross-price elasticities. Grapes only have a relationship with papaya which is a substitute. Mangoes/guavas are compliments with papaya and avocados probably because of fruit salad diets. However, the significant relationships between mangoes/guava and tomatoes and pepper is against our expectations though this could be due to combining mangoes, pepper, and tomatoes to make salsa.

As expected tomatoes have a complimentary relationship with cucumbers and peppers as they are mainly cooked together or consumed in combination as vegetable salads. The lack of relationship between asparagus and the other vegetables and the substitutability between most of the fruit with asparagus is striking given the fact that there are no ready combinations of fresh asparagus and fresh fruits.

Conclusions

In this paper, LA/AIDS model was used to estimate the demand for U.S. tropical fresh fruit and vegetable imports namely bananas, pineapples, papaya, mangoes/guavas, grapes, avocados, tomatoes, cucumbers, peppers, and asparagus. To capture seasonality and the effect of trade policy, we introduce trigonometric seasonality, trend, and a dummy variable for NAFTA. Results show that NAFTA trade block significantly impacted papayas, tomatoes and pepper positively due to improved accessibility but had a negative effect on budget shares for bananas and pineapples as it resulted in entry of more varieties of fresh produce.

Most fresh fruits and vegetable import shares are shown to significantly and positively respond to real income/expenditures implying that consumer income is a major factor in determining fresh fruit and vegetable imports into the U.S. Six out of the ten commodities show that own commodity prices are very important in deciding the imports.

Except for bananas, all the fresh fruits and vegetables show a positive trend in import budget shares. Trigonometric seasonality coefficients show the presence of seasonality in the budget shares for all the commodities. However further modeling of the nature of seasonality is required to capture the phase and amplitude of the seasonality. Since an earlier attempt was futile, perhaps the best approach would be to divide the data into decades to alleviate the problem of the cycle phases overlapping over a long period due to entry of new trading partners. Another approach is to us an error correction model which is currently being explored.

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Table 1: Estimates of LA/AIDS model of with homogeneity and symmetry.

	Fresh Bananas	Fresh Pineapple	Fresh Papaya	Fresh Mango/ Guava	Fresh Grapes	Fresh Avocado	Fresh Tomatoes	Fresh Pepper	Fresh Cucumber	Fresh Asparagus
Intercept , αi	-.0556	.1036	.0636**	.2635**	.3222	-.0078	-.0957	.3314**	.1127	-.0379
	(.5662)	(.1038)	(.0318)	(.1315)	(.3570)	(.1698)	(.4452)	(.1561)	(.1419)	(.0993)
Fresh Bananas	.2038***									
	(.0788)									
Fresh Pineapples	-.0238	.0301***								
	(.0162)	(.0059)								
Fresh Papaya	-.0308***	.0034	.0085***							
	(.0055)	(.0015)	(.0016)							
Fresh Mango/Guava	-.0302*	.0010	-.0027**	.0150**						
	(.0157)	(.0042)	(.0013)	(.0064)						
Fresh Grapes	-.0880	-.0153	.0181	.0043	.0590					
	(.0613)	(.0136)	(.0055)	(.0137)	(.0622)					
Fresh Avocado	-.0069	.0061*	.0000	-.0073*	.0129	.0035				
	(.0137)	(.0033)	(.0009)	(.0040)	(.0102)	(.0063)				
Fresh Tomatoes	.0399**	-.0071*	-.0024**	.0145***	-.0093	.0034	-.0143			
	(.0217)	(.0039)	(.0011)	(.0051)	(.0122)	(.0065)	(.0188)			
Fresh Pepper	.0213	-.0049	.0010	-.0115**	.0004	-.0108**	-.0145**	.0222***		
	(.0157)	(.0041)	(.0013)	(.0046)	(.0127)	(.0046)	(.0061)	(.0069)		
Fresh Cucumber	-.0126	.0013	-.0003	.0043	.0064	-.0022	-.0149***	-.0009	.0163***	
	(.0144)	(.0037)	(.0011)	(.0042)	(.0116)	(.0042)	(.0055)	(.0045)	(.0059)	
Fresh Asparagus	-.0727***	.0095**	.0053***	.0126***	.0115	.0013	.0048	-.0022	.0027	.0273***
	(.0153)	(.0042)	(.0015)	(.0042)	(.0133)	(.0032)	(.0038)	(.0039)	(.0035)	(.0057)
Real Expenditure	.0429	-.0116	-.0016	-.0181*	-.0061	.0039	.0137	-.0199*	-.0049	.0017
	(.0404)	(.0072)	(.0020)	(.0094)	(.0219)	(.0128)	(.0342)	(.0117)	(.0105)	(.0068)
Nafta	-.0532**	-.0111***	.0052***	.0032		-.0277***	.0705***	.0102*	-.0052	.0010
	(.0209)	(.0041)	(.0011)	(.0051)		(.0065)	(.0164)	(.0062)	(.0057)	(.0038)
cos	.0418***	-.0005	-.0011**	-.0180***	-	.0203***	-.0083	-.0021	.0116***	.0215***
	(.0087)	(.0017)	(.0005)	(.0023)		(.0027)	(.0068)	(.0025)	(.0023)	(.0016)
sin	-.1094***	-.0151***	-.0038***	-.0228***	-	-.0067**	.0228**	.0146***	.0170***	-.0123***
	(.0121)	(.0024)	(.0007)	(.0032)		(.0037)	(.0093)	(.0036)	(.0032)	(.0024)
Trend	-.0045***	.0008***	.0000	.0000	-	.0012***	.0006	.0011***	.0005***	.0002
	(.0006)	(.0001)	(.0000)	(.0001)		(.0002)	(.0004)	(.0002)	(.0002)	(.0001)
R^2	.934	.890	.880	.805	-	.786	.604	.762	.739	.891
DW Statistic	1.8016	2.0227	1.2849	1.879	-	1.145	2.0260	1.7732	1.842	2.3937
N	78	78	78	78	78	78	78	78	78	78

Numbers in parentheses are estimated standard errors. *, **, *** are significant at the 1 percent, 5 percent and 10 percent levels, respectively.

Table 2: Uncompensated Elasticities of Demand of U.S. Fresh Fruit and Vegetable imports.

	Fresh Bananas	Fresh Pineapples	Fresh Papaya	Fresh Mango/ Guava	Fresh Grapes	Fresh Avocado	Fresh Tomatoes	Fresh Pepper	Fresh Cucumber	Fresh Asparagus	Expenditure η_i
Fresh Bananas	-.5416*** (.1902)	-.0628 (.0404)	-.0768*** (.0135)	-.0785** (.0387)	-.2303 (.1529)	-.0199 (.0339)	.0806 (.0574)	.0418 (.0416)	-.0358 (.0361)	-.1823*** (.0380)	1.1056*** (.0993)
Fresh Pineapples	-.4798 (.3987)	-.2330 (.1493)	.0874** (.0376)	.0359 (.1063)	-.3470 (.3436)	.1608* (.0829)	-.1308 (.1038)	-.0943 (.1083)	.0452 (.0939)	.2479** (.1057)	.7077*** (.1798)
Fresh Papaya	-3.1187*** (.5527)	.3543** (.1549)	-.1202 (.1623)	-.2728** (.1387)	1.8920*** (.5738)	.0084 (.0968)	-.2263* (.1194) Fresh	.1156 (.1371)	-.0270 (.1157)	.5554*** (.1553)	.8391*** (.2039)
Fresh Mango/ Guava	-.5698 (.3883)	.0421 (.1068)	-.0631* (.0337)	-.6081*** (.1587)	.1673 (.3464)	-.1692** (.0991)	.4387*** (.1354)	-.2424** (.1234)	.1280 (.1072)	.3297*** (.1043)	.5468)** (.2352
Fresh Grapes	-.6509 (.4575)	-.1150 (.1039)	.1384*** (.0421)	.0068 (.1076)	-.3823 (.4848)	.0997 (.0775)	-.0628 (.0975)	.0077 (.1016)	.0507 (.0890)	.1014 (.0888)	.9533)** (.1670)
Fresh Avocado	-.2974 (.4928)	.2080* (.1181)	.0000 (.0334)	-.2619* (.1401)	.4361 (.3656)	-.8823** (.2227)	.0965 (.2473)	-.3939** (.1751)	-.0831 (.1516)	.0395 (.1121)	1.1387** (.4497)
Fresh Tomatoes	.2062 (.1456)	-.0462* (.0250)	-.0155** (.6920)	.0841*** (.0314)	-.0665 (.0780)	.0181 (.0395)	-1.0995*** (.1218)	-.0956*** (.0436)	-.0935*** (.0350)	.0248 (.0248)	1.0824*** (.2055)
Fresh Pepper	.2950* (.1556)	-.0414 (.0415)	.0116 (.0127)	-.1076** (.0467)	.0303 (.1286)	-.1029** (.0460)	-.1127* (.0649)	-.7570*** (.0737)	.0004 (.0465)	-.0158 (.0391)	.8000*** (.1170)
Fresh Cucumber	-.2303 (.3094)	.0317 (.0813)	-.0062 (.0243)	.0975 (.0919)	.1527 (.2545)	-.0444 (.0915)	-.3067** (.1286)	-.0084 (.1059)	**-.6415*** (.1295)**	.0625 (.0764)	.8931*** (.2291)
Fresh Asparagus	-2.2675*** (.4641)	.2909** (.1303)	.1639*** (.0464)	.3873*** (.1280)	.3470 (.4133)	.0371 (.0973)	.1383 (.1227)	-.0738 (.1263)	.0815 (.1092)	**-.1578 (.1752)**	1.0531*** (.2103)

Numbers in parentheses are estimated standard errors. ***, **, and * are significant at the 1 percent, 5 percent and 10 percent levels, respectively.

Table 3: Compensated Elasticities of Demand of U.S. Fresh Fruit and Vegetable imports.

	Fresh Bananas	Fresh Pineapples	Fresh Papaya	Fresh Mango/ Guava	Fresh Grapes	Fresh Avocado	Fresh Tomatoes	Fresh Pepper	Fresh Cucumber	Fresh Asparagus
Fresh Bananas	**-.0922 (.1938)**	-.0188 (.0398)	-.0661*** (.0134)	-.0342 (.0386)	-.0851 (.1509)	.0116 (.0338)	.2645*** (.0533)	.1519*** (.0385)	.0150 (.0353)	-.1465*** (.0377)
Fresh Pineapples	-.1922 (.4068)	**-.2049 (.1485)**	.0943** (.0375)	.0643 (.1065)	-.2541 (.3405)	.1810** (.0830)	-.0130 (.0984)	-.0238 (.1025)	.0777 (.0928)	.2804*** (.1051)
Fresh Papaya	-2.7776*** (.5639)	.3877** (.1541)	**-.1121 (.1624)**	-.2392* (.1390)	2.0022*** (.5697)	.0323 (.0970)	-.0867 (.1136)	.1992 (.1308)	.0116 (.1147)	.5940*** (.1546)
Fresh Mango/ Guava	-.3475 (.3924)	.0639 (.1059)	-.0578* (.0336)	**-.5862*** (.1590)**	.2391 (.3426)	-.1537 (.0991)	.5297*** (.1275)	-.1880 (.1161)	.1531 (.1055)	.3474*** (.1038)
Fresh Grapes	-.3475 (.3924)	.0639 (.1059)	-.0578*** (.0336)	-.5862 (.1590)	**.2391 (.3426)**	-.1537 (.0991)	.5297 (.1275)	-.1880 (.1161)	.1531 (.1055)	.3474 (.1038)
Fresh Avocado	.1654 (.4829)	.2533** (.1162)	.0110 (.0330)	-.2163 (.1395)	.5856 (.3588)	**-.8499*** (.2229)**	.2859 (.2297)	-.2806* (.1615)	-.0308 (.1481)	.0763 (.1109)
Fresh Tomatoes	.6462*** (.1302)	-.0031 (.0235)	-.0050 (.0066)	.1274*** (.0307)	.0756 (.0733)	.0489 (.0393)	**-.9194*** (.1131)**	.0122 (.0364)	-.0437 (.0333)	.0610*** (.0227)
Fresh Pepper	.6202*** (.1572)	-.0095 (.0410)	.0194 (.0127)	-.0756 (.0467)	.1354 (.1271)	-.0801* (.0461)	.0204 (.0609)	**-.6774*** (.0696)**	.0372 (.0456)	.0101 (.0389)
Fresh Cucumber	.1327 (.3123)	.0673 (.0803)	.0024 (.0241)	.1333 (.0918)	.2700 (.2516)	-.0190 (.0916)	-.1582 (.1204)	.0805 (.0988)	**-.6005*** (.1275)**	.0915 (.0759)
Fresh Asparagus	-1.8394*** (.4729)	.3329* (.1293)	.1741*** (.0463)	.4294*** (.1283)	-3.5647*** (.4082)	.0670 (.0974)	.3135*** (.1164)	.0311 (.1196)	.1299 (.1078)	**-.1237 (.1747)**

Numbers in parentheses are estimated standard errors. ***, **, and * are significant at the 1 percent, 5 percent and 10 percent levels, respectively. Own elasticities of demand are in bold.