A SOURCE-DIFFERENTIATED ANALYSIS OF TROPICAL FRESH FRUIT IMPORTS

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ABSTRACT

A source-differentiated Almost Ideal Demand System model is used to analyze U.S. demand for the major tropical fresh fruit imports from different countries of origin. The tropical fresh fruits chosen for analysis include fresh bananas, fresh pineapples, papayas, and mangoes/guavas. To address endogeneity problem, we utilized an iterative 3SLS estimation method. Results show that consumer incomes are a major determinant of tropical fresh fruit import demand and most of the tropical fresh fruit imports are luxury commodities. U.S. consumers have a preference for Guatemalan and Costa Rican bananas, Costa Rican and Honduras pineapples, and Ecuador and Mexican mangoes. A competitive relationship exists between bananas from Ecuador and Colombia, Ecuador and Costa Rica, Costa Rica, and Ecuador and bananas in general face competition from the other tropical fresh fruits, particularly from most pineapple and mango sources, and all the other fresh fruit imports. Based on the study findings, the countries of origin could determine how they could increase their products market share in the U.S. and likely impact of price changes of their commodity. For example, Mexico could utilize price competition strategies to retain and regain its declining U.S. mango market share.

KEY WORDS: Tropical Fresh Fruits, Source-Differentiated AIDS model, Import Demand.

Introduction

The demand for fresh fruits has been on the rise in the U.S. for the last three decades due to a combination of factors. Rising consumer incomes and an increased awareness of the health benefits of eating more fresh fruits have resulted in increased per capita consumption of fresh fruits. The heightened influx of an immigrant population accustomed to fresh-produce diets, mainly Asian and Hispanic populations, has impacted this demand for fresh fruits (Dimitri, Tegene, and Kaufman 2003). The largely unfavorable U.S. continental climate, on the other hand, restricts the ability of U.S. producers to respond to the rising demand, making imports the more viable solution to satisfy the rising demand for fresh fruits (Guthrie 2004; Huang and Huang 2007).

Free trade agreements, such NAFTA and CAFTA, and technological advances in shipping and handling of fresh produce have also provided additional access for fresh fruit imports over longer periods of time. Thus, the importance of imports to U.S. fresh fruit consumption continues to grow. According to USDA reports, between 1985 and 2005, the import share of U.S. fruit consumption rose from 2.3 percent to 15.5 percent for citrus and from 41.2 percent to 53 percent for noncitrus fruits (USDA, 2007). The import share is even higher for U.S. tropical fruits consumption, due to climatic factors. U.S. annual value of fresh fruits and vegetable imports increased from 67 million to 77.8 million U.S. constant dollars from 1992 to 2006, of which fresh fruits were the primary imports (Huang and Huang 2007). The main fresh fruit imports comprise of bananas (44 percent), grapes, and tropical fruits. Most of the se fruits largely originate from banana-exporting countries, the southern hemisphere, and Mexico. Despite these developments, few studies have examined demand for fresh fruits imports, particularly tropical fruits. Many of the available studies focus on the competitiveness of U.S.

farm fresh produce in general or in the domestic market (Cook 2001; Pollack 2001; You, Epperson, and Huang 1996) and on the main U.S. export markets for fresh produce (Andayani and Tilley 1997; Schmitz and Seale 2002; Yang and Koo 1994; Seale, Sparks, and Buxton 1992; Sparks 1992; Lee, Seale, and Jierwiriyapant 1990). Little reference has been made to the U.S. fresh fruit import market except for bananas and the import demand for fruit juices (Fonsah and Muhammad 2008).

This paper analyzes the demand for U.S. imports of the top tropical fresh fruits to determine the demand relationships of the fresh fruit imports from different countries of origin. The objective of the study is to provide reliable estimates of the elasticities of demand of U.S. tropical fresh fruit import demand. The estimates are free from aggregation bias over import sources or over goods, and provide valuable information to the fresh fruit industry. A source-differentiated Almost Ideal Demand System (AIDS) model is utilized to analyze the U.S. demand for top tropical fresh fruits and to determine the demand relationships of the leading U.S. tropical fresh fruit sources.

Model Approach

Both the Armington trade model and the AIDS model are commonly used in the literature to analyze source-differentiated import demands. However, the Armington model is criticized due to its assumptions of constant elasticity of substitution and homotheticity (Henneberry and Hwang 2007). In contrast, the AIDS model represents a flexible, complete demand system and does not require the additivity of utility function. The AIDS model satisfies the axioms of choice and aggregates perfectly under certain conditions over consumers, giving it many advantages over the Armington model.

Because the main objective of this chapter is to analyze the competitiveness of sources of U.S. tropical fresh fruits, a source-differentiated AIDS (SDAIDS) model is preferred. The SDAIDS model was proposed by Yang and Koo (1994). The model closely follows the derivation of the AIDS model by Deaton and Muellbauer (1980) and has been used in import demand studies (Boonsaeng 2006; Henneberry and Hwang 2007; Yang and Koo 1994; Boonsaeng, Fletcher, and Carpio 2008). The SDAIDS allows for source differentiation of various tropical fresh fruits without imposing block separability. Its main advantage is that it does not suffer from aggregation bias over import sources or over products.

The SDAIDS employed follows Henneberry and Hwang (2007) and Yang and Koo (1994) as

$$w_{ih} = \alpha_{ih} + \sum_{j} \sum_{k} \gamma_{ihJk} \ln(p_{jk}) + \beta_{ih} \ln(E / P^*) \qquad (1)$$

$$h = 1, 2, 3, ..., m \text{ and } k = 1, 2, 3, ..., n$$

where, i and j represent commodities, and h and k indicate countries of origin for the goods. Commodity i may be imported from m different sources and j may be from n different sources. w_{i_h} is the budget share of good i imported from source h and p_{j_k} is the price of good j imported from source k. The term E denotes the total expenditure on all the goods in the demand system, while P^* is a price index defined as

$$\ln p^* = \alpha_0 + \sum_{i} \sum_{h} \alpha_i \ln(p_{i_k}) + \frac{1}{2} \sum_{i} \sum_{h} \sum_{j} \sum_{k} \gamma^*_{i_h j_k} \ln(p_{i_h}) \ln(p_{j_k}) \qquad (2)$$

The index P^* is nonlinear, making the SDAIDS model nonlinear, also. Several alternative forms can be used to transform the system to a linear approximation. These include a regular price index proposed by Moschini (1994), the Tornquist index, the "corrected" Stone index, and the geometrically weighted average of prices (Moschini 1994, 1995; Moschini and

Meilke 1989). The geometrically weighted average of prices is chosen as the alternative price index here. The geometric weighted average price index is expressed as

$$\log\left(P_t^C\right) = \sum_{i=1}^{n} w_i^0 \log\left(p_{it}\right). \tag{3}$$

This geometrically weighted index is an analogue of the Laspeyres price index and does not change with changes in units of measurement up to a multiplicative constant, allowing further simplification necessary for an approximating index.

The SDAIDS involves large number of estimated parameters, due to the number of sources per each commodity, and thus creates a degrees of freedom problem. This problem is addressed by imposing restrictions on the parameters, as in Yang and Koo (1994), so that

$$\gamma_{i_h j_k} = \gamma_{i_h j} \qquad \forall k \in j \neq i$$

which implies that the cross-price effects are not source differentiated between products but are differentiated within a product. For instance, U.S. demand for Mexican mangoes have no source differentiated cross-price effects with demand for Chilean pineapples and other countries, but they do have source-differentiated cross-price effects with demand for mangoes from Chile or other countries. The assumption results to the following restricted SDAIDS (RSDAIDS) model:

$$w_{i_h} = \alpha_{i_h} + \sum_k \gamma_{i_h k} \ln(p_{ik}) + \sum_{j \neq i} \gamma_{i_h j} \ln(p_j) + \beta_{i_h} \ln\left(\frac{E}{P^T}\right) \tag{4}$$

The Marshallian elasticities of demand are then calculated, as in Andayani and Tilley (1997), using the following formulae:

$$\in_{i_h i_h} = 1 + \frac{\gamma_{i_{hh}}}{w_{i_h}} - \beta_{i_h} \qquad \text{(own-price elasticity)},$$

$$\in_{i_h i_k} = \frac{\gamma_{i_{hh}}}{w_{i_h}} - \beta_{i_h}\left(\frac{w_{i_k}}{w_{i_h}}\right) \quad \text{(cross-price elasticities of fresh product } i \text{ among sources)},$$

$$\epsilon_{i_h j} = \frac{\gamma_{i_{hh}}}{w_{i_h}} - \beta_{i_h}\left(\frac{w_{i_k}}{w_{i_h}}\right)$$ (cross-price elasticity among fresh produce and sources), and

$$\eta_{i_h} = 1 + \frac{\beta_{i_h}}{w_{i_h}} .$$

Since monthly data are utilized, consumption is unlikely to be in equilibrium due to habit persistence, adjustment costs, imperfect information and incorrect expectations, all of which may interfere with instant expenditure adjustment to prices and income changes. Nonstationarity and cointegration in the data could make the estimated parameters inconsistent. It is important that stationarity and cointegration tests are undertaken to determine whether the time series data are nonstationary and cointegrated. If the expenditure shares, prices, and real expenditure are cointegrated, a dynamic SDAIDS model is more appropriate. Although the inclusion of lagged dependent and lagged residuals in the dynamic model may have been more appropriate, owing to degrees of freedom limitations, we estimate a lagged static model.

Data

Monthly data from January 1989 to December 2008 are used to estimate the parameters of the Source-Differentiated AIDS model. The data are monthly quantities and Cost, Insurance, and Freight (CIF) import values obtained from the Foreign Agricultural Service of USDA. The tropical fresh fruit chosen for estimation include bananas, pineapples, papayas, mangoes/guavas, grapes, and other fruits. CIF values are chosen because they include shipping costs of the tropical fresh fruits.

The U.S. imports tropical fresh fruits from various sources. The top countries that supply tropical fresh fruit imports are identified for analysis. The source-differentiated imports of bananas are from Colombia, Costa Rica, Ecuador, Guatemala, and the rest-of-the-world (ROW).

Pineapples imports are sourced from Mexico, Honduras, Costa Rica, and the rest-of-the-world (ROW), while papayas are imported from Brazil, Mexico and the ROW. Mangoes/guavas import sources are sourced from Ecuador, Guatemala, Mexico, and the ROW. Other fresh fruits are not source differentiated. The summary of the sample source-differentiated shares, quantities and unit values is presented in Table 1.

Table 1. Monthly Average Quantities, Values, Prices, and Expenditure Shares of U.S. Tropical Fresh Fruits Imports, 1989:1 – 2008:12.

Tropical Fresh Fruit	Monthly Average		
	Quantity (MT)	Unit Value (US $/MT)	Expenditure Share
Bananas			
Colombia	47358.32	380.17	0.0928
Costa Rica	80899.91	351.48	0.1560
Ecuador	83963.90	356.31	0.1659
Guatemala	57201.53	346.06	0.1031
ROW	58621.66	368.34	0.1197
Pineapples			
Mexico	1304.96	379.34	0.0023
Honduras	2102.68	601.44	0.0051
Costa Rica	20378.54	563.16	0.0359
ROW	2724.01	635.36	0.0043
Papayas			
Brazil	196.51	1175.05	0.0004
Mexico	4029.92	567.06	0.0073
ROW	1352.81	1086.50	0.0019
Mangoes/Guavas			
Ecuador	1037.22	933.52	0.0013
Guatemala	557.04	969.67	0.0005
Mexico	11353.18	1865.74	0.0079
ROW	3384.84	1541.40	0.0046
Other Fruits			
World	175411.93	1004.41	0.2912

The prices of fresh fruits imports are not available, and, therefore, unit values are calculated and used as measures of market values of the imported fresh tropical fruits. The quantity data are in metric tons (MT), while the import values are in thousands of dollars (US$1000). The import price (unit value) of each source-differentiated fresh fruit is calculated by dividing the total monthly import value by the total monthly import quantity. In the event that prices were missing because of zero imports from a country, world import prices for the specific fresh fruit imports are utilized.

Endogeneity Tests

Since expenditures and prices are used to calculate the import real income/expenditure in equation 6.4, the expenditures and prices may not be exogenous. Another problem is that of import quantities being determined in advance through import quotas and SPS requirements, and then prices being determined by demand forces given the fixed supply. This would imply that the tropical fresh fruit prices are endogenous. Moreover, lags in production response to prices, such as in production of perennial fresh fruits, could also lead to simultaneity bias (Henneberry and Hwang 2007) in the short run.

The Wu-Hausman test was used to test for endogeneity in prices and expenditure variables. The test involves regressing potential endogenous variables on a set of instrumental variables (auxiliary regression). The instrumental variables chosen for the auxiliary regression are lagged source-differentiated prices and lagged expenditure shares. The residuals from the auxiliary regression are included in the SDAIDS model. A test on whether the coefficients of the residuals are statistically equal to zero concludes the endogeneity test. If the coefficients are found to be statistically significant, the conclusion is that endogeneity exists. The results of the endogeneity test are presented in Table 2. From the results, there exists endogeneity in the expenditure, the prices of bananas from Ecuador, Guatemala, and the ROW; prices of papayas from Brazil, and prices of mangoes from Mexico and Guatemala. Test results suggest that pineapple prices and other fresh fruits are exogenous, implying that producers are able to respond to price changes in the short run.

Table 2. Endogeneity Test Results of Expenditure and Prices of U.S. Tropical Fresh Fruits Imports, 1989:1 – 2008:12.

Variable	Test Results		
Expenditure	F	=	3.4204***
Prices			
Bananas			
Colombia	F	=	1.1361
Costa Rica	F	=	1.5846
Ecuador	F	=	2.2751**
Guatemala	F	=	2.2950**
ROW	F	=	3.2838***
Pineapples			
Mexico	F	=	0.3233
Honduras	F	=	-0.1073
Costa Rica	F	=	-1.2881
ROW	F	=	-0.4486
Papayas			
Brazil	F	=	3.5429***
Mexico	F	=	1.0136
ROW	F	=	-1.3628
Mangoes/Guavas			
Ecuador	F	=	-0.3498
Guatemala	F	=	-1.9597
Mexico	F	=	-3.3260**
ROW	F	=	0.5283
Other Fruits			
World	F	=	0.9683

***, **, and * denote significance at the 1 %, 5%, and 10% levels, respectively.

Empirical Results

Since some of the prices and expenditures were found to exhibit endogeneity, the SDAIDS model is estimated using three-stage least squares (3SLS) method of estimation. Because tropical fresh fruit shares equal to one, the import expenditure share equation for the ROW was excluded from estimation to avoid singularity. The coefficients of the dropped equation were then calculated using the adding-up restriction. Results of the estimated SDAIDS are presented in Table 3.

Commodities with significant the intercepts, $\alpha_i's$ include bananas form Colombia, Costa Rica, Ecuador, and the ROW, pineapples from Costa Rica, mangoes/guavas from Ecuador, Mexico, and the ROW, Papayas from the ROW, and all other fruit imports. The real expenditure parameters for mangoes/guavas from Mexico, Ecuador, and the ROW, papayas from Mexico and the ROW, pineapples from Costa Rica, and all other fresh fruit imports are positive and significant. This suggests that these commodities are luxury goods confirming that tropical fruit imports are considered exotic. Bananas from Colombia, Costa Rica, and the ROW are shown to have negative and significant real expenditure coefficients implying that they are necessities. Again this finding is consistent with the fact that bananas are very popular fruits among U.S. consumers and considered staples.

Own-price coefficients that are statistically significant include bananas from Guatemala, pineapples from Mexico, Honduras, and Costa Rica, papayas from Mexico, mangoes/guavas from Guatemala, Mexico, and the ROW. The estimated cross-price coefficients for Colombian and Costa Rican bananas, Ecuadorian and Guatemalan bananas, Costa Rican and the ROW bananas, Honduran and the ROW pineapples, Brazilian and the ROW papayas, and Ecuadorian and Mexican mangoes/guavas are positive and significant. This implies that these commodities are substitutes, which is expected.

The uncompensated and compensated elasticities of demand were calculated at sample means and are presented in Tables 4 and 5, respectively. The uncompensated and compensated elasticities are nearly identical, most likely because fresh fruits consumption comprises a very small proportion of U.S. consumers' expenditures. We therefore concentrated only on the compensated elasticities for our discussion. All the source-differentiated expenditure elasticities are positive, with the exception of the insignificant expenditure elasticities for bananas from Colombia and the ROW. Except for bananas, all the fresh fruit sources' expenditure elasticities are greater than one. This result is consistent with the general knowledge that excluding bananas, which are staple and popular fresh fruits in the U.S., tropical fresh fruits are exotic and luxury commodities to the American consumer.

Within bananas' differentiated sources, only Guatemalan bananas have a significant, elastic expenditure elasticity of 1.1756. This finding suggests that U.S. tropical fresh fruit consumers have a preference for Guatemalan bananas over bananas from Ecuador, Colombia, Costa Rica, and the ROW. The rest of bananas sources' expenditure elasticities are very inelastic, suggesting that bananas are staple food commodities.

Papayas, pineapples, mangoes/guavas, and all the other fresh fruit imports are luxury commodities, as are shown by the positive estimated expenditure elasticities that are greater than one and statistically significant over all the sources (except for Mexican pineapples, Brazilian papayas, and Guatemalan mangoes/guavas, which are greater than one but statistically insignificant). For pineapples, estimation results show that Honduras, Costa Rica, and the ROW have positive and significant expenditure elasticities of 1.492, 2.174, and 1.4565, respectively.

These elasticities suggest that Costa Rican pineapples are preferred over other pineapples. The estimated expenditure elasticities for papayas differentiated sources show U.S. tropical fresh consumers have a preference for ROW, and Costa Rican papayas are preferred to Brazilian papayas, with the ROW being the most preferred.

The source-differentiated expenditure elasticity estimates for mangoes/guavas show that Mangoes/guavas are strong luxury goods. The estimated expenditure elasticities for mango/guava range from 1.9719 for Mexico to 6.0297 for ROW. Expenditure elasticities for Ecuador and the ROW mangoes are 4.0617 and 6.097, respectively, implying that they are highly preferred by U.S. tropical fresh fruit consumers over mangoes/guavas from Guatemala and Mexico. Other fresh fruit imports have an elastic expenditure at 2.3855.

Consistent with economic theory, the estimated own-price elasticities of the SDAIDS have the expected negative sign, with the exception of Mangoes/guavas from the ROW and the insignificant own-price elasticities for Guatemalan bananas and mangoes/guavas, Costa Rican pineapples, and Honduras. Among these, own-price elasticities for mangoes/guavas from Ecuador and Mexico and papayas from the ROW are greater than one and statistically significant. Among these own-price elasticities that are greater than one include: mangoes/guavas produced in Ecuador, Guatemala, Mexico, and the ROW; papayas from Brazil and ROW; and bananas from Colombia. This result suggests that these fresh fruits are very sensitive to price changes. Inelastic and significant own-price elasticities estimates were found for bananas from Ecuador, Costa Rica, and the ROW, pineapples from Honduras, and the ROW, and all other fresh fruit imports. Surprisingly, mangoes/guavas from the ROW are found to have a large, positive, and significant own elasticity suggesting that they are giffen goods.

The cross-price elasticities indicate whether tropical fresh fruits from various sources have substitutability and complementary demand relationships however the interpretation should be taken with some caution. Tropical fresh fruit production and importations are controlled three U.S. multinational companies namely Del Monte, Chiquita, and Dole and source-differentiation could also imply the companies' country substitutability. However, these companies are expected to make production location and import source choices based on production and shipping cost, and most important consumer quality preferences and so the consumer preferences of source-differentiated fresh fruits are indirectly implied.

Within tropical fresh fruits, bananas are shown to have the highest competition amongst sources. The cross-price elasticities of demand of bananas from Ecuador and those from Costa Rica, Colombia, and the ROW, and bananas from the ROW and Colombia, Costa Rica, and Ecuador are found to be positive and statistically significant. This implies that bananas from these sources are significant substitutes and with each other. The highest competition amongst bananas sources is between Ecuador and Colombia, and Costa Rica and ROW, based on the magnitude of the cross-price elasticities. Significant complementary bananas sources include Guatemala and Ecuador, and Colombia and Costa Rica as the respective cross-price elasticities are negative and significant. These results confirm prior expectations for steep competition among U.S. banana suppliers.

For pineapples, significant source substitutes are Mexico and Costa Rica, and Costa Rica and the ROW, while complementary pineapple sources include Costa Rica and Honduras, and Honduras and the ROW. The results also show that papayas from Brazil and the ROW are very strong substitutes, as the cross-price elasticities of demand are positive, greater than one, and significant. Regarding the mango/guava market, significant substitutes include Mexico and Ecuador, and complementary mangoes/guavas sources include Guatemala and Mexico.

Among cross-commodity relationships, many pineapples, mangoes/guavas, and papaya sources are shown to be significant substitutes for bananas sources. This result is expected, given the growing entry of other tropical fresh fruits in to the U.S. market and the subsequent reduction of the market share for bananas in the past decade. Colombian bananas are shown to be substitutes with pineapples from Mexico and Costa Rica, mangoes from Mexico, and all the other fresh fruit imports, and they demonstrate a weak complementary relationship with Ecuador mangoes and ROW papayas.

Costa Rican bananas are substitutes with pineapples from Mexico, Honduras, and the ROW, papayas from Mexico and the ROW, mangoes/guavas from Mexico, and all other fruit imports. Bananas from Ecuador show a substitutability relationship with Mexican mangoes, ROW papayas and other fruits and demonstrate a weak complementary relationship with Mexican pineapples and papayas. Guatemalan bananas show a weak complementary relationship with mangoes from Guatemala and Mexico and pineapples from Mexico while showing substitutability with Mexican mangoes, ROW papayas, and other fresh fruits. Bananas from the ROW are found to be substitutes with pineapples from Honduras, mangoes from Ecuador, and other fresh fruit imports, and complementary with Brazilian papayas.

Among pineapple and papaya sources, significant substitutes include Mexican papayas and pineapples (1.1693), and Costa Rican pineapples with Brazil papayas (9.2115), and ROW pineapples with Mexican papayas. There are no significant complementary relationships between papaya and pineapple sources. Similarly, there are significant substitute relationships between pineapple sources and mango/guava sources or other fruits. However, complementary relationships exist for pineapples from the ROW and for Mexican and the ROW mangoes, other fruit imports, Mexican pineapples and Guatemalan mangoes, and other fruit imports.

With regard to papaya and mango sources, Mexican papaya show a significant complementary relationship with Guatemalan and Mexican mangoes, as are the ROW papayas and other fresh fruit imports. Fresh mango/guava differentiated-source cross-price elasticities show that all the other fresh fruit imports are significant substitutes with mangoes from Guatemala, Mexico, and the ROW. Except for Pineapples from Mexico and the ROW, and papayas from the ROW, other fresh fruits are shown to compete with most tropical fresh fruit imports, as most of the cross-price elasticities are positive and significant at the 1 and 5 percent levels.

Table 3. Estimated coefficients of SDAIDS for U.S. tropical fresh fruit imports, 1989–2008.

	BANCO	BANCR	BANEC	BANGT	BANROW	PINMX	PINHN	PINCR	PINROW	PAPBR	PAPMX	PAPROW	MANEC	MANGT	MANMX	MANROW	OTH
α_i	1.4474***	1.9172***	2.1663*	-0.1462	1.8707***	-0.0351	-0.0029	-0.6388***	-0.0225	-0.0389	-0.0589	-0.0575*	-0.0508**	-0.0233	-0.0954***	-0.2935**	-5.0201***
	0.1295	0.1562	0.1767	0.1495	0.1515	0.0443	0.0313	0.0807	0.0286	0.0357	0.0359	0.0327	0.0241	0.0311	0.0394	0.1445	0.2109
	-0.0184***																
lnP BANCO	0.0172																
	-0.0488***	-0.0141															
lnP BANCR	0.0112	0.0165															
	0.0737	0.0058	0.0218														
lnP BANEC	0.0141	0.0142	0.0231														
	0.0107	-0.0177	-0.0657***	0.1110***													
lnP BANGT	0.0125	0.0125	0.0154	0.0176													
	0.015	0.0724***	-0.0015	-0.0296**	0.0224												
lnP BANROW	0.0137	0.0135	0.0041	0.0137	0.021												
	0.0108***	0.0108***	-0.0215	0.0093***	0.0002	0.0022*											
lnP PINMX	0.0033	0.0032	0.0057	0.0035	0.0038	0.0013											
	0.0023	0.0113***	-0.0004	-0.0123***	0.0036*	0.0004	0.0037***										
lnP PINHN	0.0016	0.0018	0.0021	0.0018	0.0019	0.0005	0.0005										
	-0.0056	-0.0097	-0.0119	-0.0126**	-0.0157**	0.0028	-0.0058***	0.0426***									
lnP PINCR	0.0063	0.0065	0.0078	0.007	0.0075	0.0017	0.001	0.005									
	0.0031	0.0038	-0.0035	0.0075***	-0.0045	0.001	-0.0013***	0.0036***	0.0004								
lnP PINROW	0.0026	0.0023	0.003	0.0026	0.0028	0.0008	0.0004	0.0012	0.0009								
	0.0092	-0.0013	0.0006	0.0117***	-0.0182***	0.0007	0	0.0040**	-0.0004	-0.0005							
lnP PAPBR	0.0032	0.0029	0.0036	0.0031	0.0034	0.0009	0.0004	0.0016	0.0007	0.0012							
	-0.0057	0.0082	-0.0130***	0.0023	0.0046	0.0026***	-0.0007**	0.0015	0.0027***	0.0006	0.0070***						
lnP PAPMX	0.0032	0.0028	0.0038	0.0031	0.0035	0.001	0.0004	0.0015	0.0008	0.0009	0.0013						
	-0.0078*	0.0056	0.0057*	-0.0003	-0.0005	0.0003	-0.0002	-0.0002	-0.0006	0.0023***	-0.0003	-0.0003					
lnP PAPROW	0.0031	0.0027	0.0034	0.0029	0.0033	0.0009	0.0004	0.0015	0.0007	0.0008	0.0009	0.0011					
	-0.0127***	-0.0019	0.0026	0.0045*	0.0047*	-0.0006	-0.0004	0.002	0.0003	0000	0.0006	-0.0002	-0.0003				
lnP MANEC	0.0025	0.0021	0.0029	0.0023	0.0026	0.0007	0.0003	0.0011	0.0006	0.0007	0.0007	0.0007	0.0008				
	0.0002	-0.0027	-0.003	-0.0045*	0.0015	-0.0014**	0.0004	-0.0011	-0.0005	-0.0005	-0.0014**	-0.001	0.0004	0.0015**			
lnP MANGT	0.0023	0.0022	0.0027	0.0024	0.0026	0.0007	0.0003	0.0012	0.0005	0.0006	0.0006	0.0006	0.0005	0.0006			
	0.0049***	0.0043	0.0034	-0.0127***	0.003	-0.0003	0.0004	-0.0066	-0.0011***	-0.0013***	-0.0016***	0.0003	0.0015***	-0.0009**	-0.0049***		
lnP MANMX	0.0016	0.0019	0.0021	0.0019	0.002	0.0006	0.0004	0.0011	0.0003	0.0004	0.0004	0.0004	0.0003	0.0004	0.0006		
	-0.0203	-0.035	0.0242	-0.0041	-0.0269	-0.0058	-0.0019	0.0003	-0.0056*	-0.0039	-0.003	0.0035	0.0002	0.0035	-0.0019	0.0463**	
lnP MANROW	0.0139	0.0121	0.0163	0.0133	0.0155	0.005	0.0017	0.0063	0.0032	0.0037	0.0044	0.0037	0.0031	0.0027	0.0018	0.0229	
	-0.0107	0.009	-0.0174*	0.0025	-0.0303***	-0.0115***	0.0009	0.0125***	-0.0047***	-0.0031	-0.0045**	-0.0062***	-0.0009	0.0095***	0.0133***	0.0302***	0.0114
lnP OTH	0.0072	0.0095	0.0104	0.0085	0.0092	0.0024	0.0019	0.0048	0.0016	0.0019	0.0019	0.0017	0.0012	0.0017	0.0022	0.0099	0.0151
β_i	-0.1025***	-0.1330***	-0.1518***	0.0181	-0.1328***	0.0029	0.0008	0.0509***	0.0019	0.0029	0.0050*	0.0045*	0.0040**	0.0018	0.0077***	0.0230**	0.4035***
	0.0098	0.0118	0.0133	0.0113	0.0114	0.0033	0.0024	0.0061	0.0022	0.0027	0.0027	0.0025	0.0018	0.0023	0.003	0.0109	0.016
R -Sq	0.6098	0.5897	0.7292	0.5231	0.7213	0.1143	0.2669	0.6852	0.3522	0.0983	0.6262	0.0693	0.3228	0.0114	0.1435		0.8195
DW- Stat	1.3612	0.9883	0.8234	0.5851	0.7567	0.738	1.443	0.8493	0.8419	0.7774	0.6906	0.685	1.1249	0.9879	0.8488		1.1372
N =	239		E'PZ*E =	521.377													

Below the estimated parameters, are the respective standard errors. PIN=Pineapples, BAN=Bananas, PAP=Papaya, MAN=Mango/Guava, OTH=All other fresh fruits, EC=Ecuador, CO=Colombia, CR=Costa Rica, GT=Guatemala, MX=Mexico, HN=Honduras, BR=Brazil, and *lnP*=price log.

Table 4. Uncompensated and Expenditure Elasticities for Source-Differentiated ECM- AIDS for U.S. Tropical Fresh Fruit Imports and domestic supply, 1989–2008.

		Bananas					Pineapples				Papaya			Mangoes/Guavas				Other Fruits	Expenditure
		Colombia	Costa Rica	Ecuador	Guatamala	ROW	Mexico	Honduras	Costa Rica	ROW	Brazil	Mexico	ROW	Ecuador	Guatemala	Mexico	ROW	World	
Bananas	Colombia	-1.0957***	-0.3535**	0.9771***	0.2291*	0.2943**	0.1192***	0.0310*	-0.0207	0.0380	0.1000***	-0.0533	-0.0823**	-0.0797***	0.0017	0.0402***	-0.2141	0.2058**	-0.1043
		0.1867	0.1235	0.1459	0.1363	0.1491	0.0361	0.0169	0.0681	0.0284	0.0343	0.0348	0.0329	0.0161	0.0139	0.0105	0.1500	0.0839	0.1054
	Costa Rica	-0.2336***	-0.9576***	0.1784*	-0.0257	0.5661***	0.0710***	0.0770***	-0.0318	0.0283*	-0.0078	0.0586***	0.0373**	-0.0113	-0.0159	0.0346***	-0.2202***	0.3061***	0.1477*
		0.0720	0.1062	0.0880	0.0811	0.0873	0.0206	0.0116	0.0422	0.0150	0.0186	0.0181	0.0170	0.0135	0.0135	0.0124	0.0772	0.0679	0.0757
	Ecuador	0.5289***	0.1775**	-0.7166***	-0.3015***	0.1008***	-0.1277***	0.0020	-0.0389	-0.0174	0.0043	-0.0716***	0.0364*	0.0171	-0.0177	0.0278**	0.1160**	0.1615**	0.0847
		0.0855	0.0875	0.1331	0.0946	0.0290	0.0346	0.0126	0.0476	0.0183	0.0216	0.0232	0.0204	0.0173	0.0164	0.0129	0.0502	0.0722	0.0804
	Guatemala	0.0875	-0.1993	-0.6661***	0.0592	-0.3082**	0.0896***	-0.1203***	-0.1287*	0.0716***	0.1135***	0.0211	-0.0028	0.0437*	-0.0442*	-0.1250***	-0.0403	-0.0269	1.1756***
		0.1217	0.1216	0.1435	0.1733	0.1344	0.0337	0.0172	0.0689	0.0249	0.0298	0.030	0.0284	0.0226	0.0229	0.0186	0.1293	0.0894	0.1096
	ROW	0.2286**	0.7778***	0.1720***	-0.1329	-0.6803***	0.0043	0.0357**	-0.0917	-0.0331	-0.1519***	0.0465	-0.0025	0.0409*	0.0126	0.0337*	-0.2195*	0.0697	-0.1097
		0.1146	0.1130	0.0356	0.1150	0.1761	0.0322	0.0160	0.0627	0.0232	0.0287	0.0295	0.0275	0.0221	0.0218	0.0172	0.1296	0.0835	0.0956
Pineapples	Mexico	4.6684***	4.5633***	-9.7241***	3.9681*	-0.0562**	-0.0232	0.1559	1.1823	0.4154	0.3032	1.1528**	0.1262	-0.2509	-0.6182**	-0.1248	-2.5704	-5.4279***	2.2602
		1.4930	1.4479	2.5012	1.5488	1.7150	0.5831	0.2167	0.7548	0.3452	0.3830	0.4569	0.3848	0.3058	0.3156	0.2491	2.2242	1.1732	1.4798
	Honduras	0.4463	2.1966***	-0.1104	-2.4267***	0.6855*	0.0716	-0.2755***	-1.1467***	-0.2473***	-0.0085	-0.1388*	-0.0448	-0.0748	0.0778	0.0837	-0.3637	0.1263	1.1492**
		0.3058	0.3531	0.3936	0.3546	0.3762	0.0962	0.0902	0.1972	0.0700	0.0779	0.0828	0.0767	0.0565	0.0679	0.0749	0.3400	0.4200	0.4644
	Costa Rica	-0.2875*	-0.4923***	-0.5667***	-0.4976**	-0.6083**	0.0742	-0.1695***	0.1346	0.0931***	0.1099**	0.0327	-0.0077	0.0544*	-0.0308	-0.1951***	0.0029	-0.0640	2.4174***
		0.1740	0.1816	0.2092	0.1997	0.2093	0.0474	0.0278	0.1410	0.0342	0.0432	0.0421	0.0409	0.0313	0.0336	0.0295	0.1756	0.1449	0.1699
	ROW	0.6837	0.8333	-0.9044	1.7071***	-1.1187*	0.2229	-0.2983***	0.8205***	-0.9034***	-0.0947	0.6247***	-0.1514	0.0760	-0.1229	-0.2714***	-1.3267*	-1.2329***	1.4565***
		0.6245	0.5612	0.6861	0.6062	0.6597	0.1834	0.0839	0.2894	0.2020	0.1634	0.1804	0.1663	0.1337	0.1234	0.0827	0.7559	0.3935	0.5081
papaya	Brazil	20.7308***	-4.0178	0.3607	26.3739***	-42.9911	1.5737	-0.1337	8.9311**	-0.9582	-2.2511	1.3895	5.2914***	0.0940	-1.1265	-2.9602***	-8.9396	-9.1747	7.8077
		7.3794	6.9217	7.8920	7.1516	8.0331	2.0072	0.9251	3.6016	1.6089	2.6787	1.9739	1.9078	1.5148	1.3904	0.9379	8.4454	4.5119	6.2340
	Mexico	-0.8447*	1.0149*	-1.8946***	0.2459	0.5493	0.3594***	-0.0999*	0.1875	0.3638***	0.0852	-0.0389	-0.0411	0.0830	-0.1953**	-0.2199	-0.4190	-0.8178***	1.6823***
		0.4453	0.3958	0.5023	0.4268	0.4891	0.1410	0.0578	0.2074	0.1049	0.1168	0.1863	0.1210	0.0961	0.0891	0.0600	0.6085	0.2823	0.3724
	ROW	-4.3597***	2.5738*	2.640	-0.3780	-0.5739	0.1484	-0.1324	-0.1804	-0.3486	1.2118***	-0.1708	-1.1679*	-0.1095	-0.5178	0.1198	1.8439	-3.9830***	3.3832***
		1.6288	1.4386	1.7069	1.5637	1.7694	0.4611	0.2084	0.7807	0.3748	0.4368	0.4691	0.6063	0.3628	0.3390	0.2123	1.9523	0.9864	1.3067
Mangoes/Guavas	Ecuador	-9.9856***	-1.9632	1.5089	3.1581*	3.2510	-0.4395	-0.3078	1.4393*	0.2368	0.0328	0.4464	-0.1601	-1.2444**	0.3316	1.1329	0.1040	-1.6029	4.0617***
		1.9490	1.6587	2.0987	1.7949	2.0635	0.5312	0.2226	0.8649	0.4361	0.5024	0.5391	0.5257	0.5790	0.3805	0.2228	2.3540	1.0265	1.3929
	Guatemala	0.0686	-6.4403	-7.1478	-10.2676**	2.6812	-3.0400**	0.8420	-2.4831	-1.1482	-1.0554	-3.1081**	-2.1272	-0.6848	2.2469	-2.0517**	7.6371	19.5689***	4.8881
		5.0513	4.9379	5.7065	5.1907	5.7321	1.5542	0.7535	2.6447	1.1432	1.3055	1.4191	1.3918	1.6352	1.3785	0.9142	5.9259	4.1394	5.0959
	Mexico	0.5328***	0.3991*	0.2713	-1.7143***	0.2613	-0.0351	0.0499	-0.8715***	-0.1485***	-0.1597***	-0.2051***	0.0314	0.1899***	-0.1185**	-1.6229***	-0.2401	1.4081***	1.9719***
		0.2031	0.2425	0.2641	0.2473	0.2609	0.07127	0.0483	0.1349	0.0446	0.0509	0.0554	0.0504	0.0364	0.0531	0.0823	0.2223	0.3243	0.3784
	ROW	-4.7837	-8.2121***	4.7220	-1.2590	-6.3128*	-1.2796	-0.4240	-0.0534	-1.2494*	-0.8457	-0.6895	0.7620	0.0291	0.7717	-0.4354	9.1333	5.5786**	6.0297**
		3.0852	2.7349	3.4093	2.9558	3.4753	1.1051	0.3839	1.3864	0.7059	0.8011	0.9784	0.8094	0.6740	0.5990	0.3888	5.0175	2.4155	2.3896
Other Fruits	World	-0.1654***	-0.1851***	-0.2897***	-0.1342	-0.2700***	-0.0425***	-0.0041	-0.0067	-0.0220**	-0.0113*	-0.0256***	-0.0240***	-0.0050	0.0321	0.0349***	0.0973	-1.3643	2.3855***
		0.0244	0.0315	0.0357	0.0297	0.0316	0.0084	0.0065	0.0166	0.0054	0.0064	0.0066	0.0060	0.0043	0.0059	0.0076	0.0339	0.0591	0.0549

Below the estimated elasticities, are the respective standard errors and *, **, and *** are represent significance at the 10 percent, 5 percent and 1 percent levels, respectively. Significant substitute and complementary goods are marked by red and blue colors respectively.

Table 5. Compensated Elasticities of Demand for Source-Differentiated ECM- AIDS for U.S. Tropical Fresh Fruit Imports and Domestic Supply, 1989–2008.

		Bananas					Pineapples				papaya			Mangoes/Guavas				Other Fruits
		Colombia	Costa Rica	Ecuador	Guatamala	ROW	Mexico	Honduras	Costa Rica	ROW	Brazil	Mexico	ROW	Ecuador	Guatemala	Mexico	ROW	World
Bananas	Colombia	-1.1054***	-0.3697***	0.9598***	0.2184	0.2818*	0.1190***	0.0304**	-0.0245	0.0375	0.1000***	-0.0541	-0.0825**	-0.0798***	0.0017	0.0394***	-0.2146	0.1754**
		0.1857	0.1210	0.1524	0.1352	0.1474	0.0360	0.0168	0.0676	0.0283	0.0343	0.0345	0.0329	0.0161	0.0140	0.0102	0.1501	0.0773
	Costa Rica	-0.2199***	-0.9346***	0.2029**	-0.0105	0.5838***	0.0713***	0.0777***	-0.0265	0.0289*	-0.0078	0.0597***	0.0377**	-0.0111	-0.0158	0.0358***	-0.2196***	0.3491***
		0.0720	0.1060	0.0911	0.0798	0.0864	0.0205	0.0116	0.0418	0.0149	0.0186	0.0180	0.0170	0.0135	0.0135	0.0124	0.0773	0.0606
	Ecuador	0.5368***	0.1907**	-0.7026***	-0.2927***	0.1110***	-0.1275***	0.0025	-0.0359	-0.0170	0.0043	-0.0709***	0.0365*	0.0172	-0.0176	0.0285**	0.1164**	0.1862***
		0.0852	0.0856	0.1394	0.0927	0.0248	0.0346	0.0125	0.0471	0.0183	0.0215	0.0230	0.0204	0.0173	0.0164	0.0128	0.0504	0.0629
	Guatemala	0.1966	-0.0159	-0.4711***	0.1803	-0.1675	0.0922***	-0.1143***	-0.0865	0.0766***	0.1141***	0.0296	-0.0005	0.0453**	-0.0437*	-0.1157***	-0.0350	0.3155***
		0.1217	0.1208	0.1491	0.1712	0.1330	0.0336	0.0172	0.0681	0.0248	0.0298	0.0298	0.0284	0.0226	0.0229	0.0184	0.1294	0.0827
	ROW	0.2184*	0.7607***	0.1538***	-0.1442	-0.6935***	0.0041	0.0351**	-0.0956	-0.0336	-0.1520***	0.0457	-0.0027	0.0407*	0.0126	0.0328**	-0.2200	0.0377
		0.1142	0.1126	0.0344	0.1145	0.1758	0.0321	0.0159	0.0624	0.0231	0.0287	0.0292	0.0275	0.0221	0.0218	0.0171	0.1297	0.0772
Pineapples	Mexico	4.8781***	4.9159***	-9.3492***	4.2011***	0.2144	-0.0181	0.1674	1.2635*	0.4250	0.3042	1.1693***	0.1305	-0.2480	-0.6172*	-0.1070	-2.5600	-4.7698***
		1.4764	1.4156	2.5333	1.5297	1.6960	0.5818	0.2162	0.7490	0.3439	0.3828	0.4531	0.3847	0.3054	0.3158	0.2477	2.2262	1.0781
	Honduras	0.5529*	2.3759***	0.0803	-2.3082***	0.8231**	0.0742	-0.2696***	-1.1055***	-0.2424***	-0.0080	-0.1304	-0.0427	-0.0733	0.0783	0.0927	-0.3584	0.4610
		0.3059	0.3532	0.4055	0.3464	0.3734	0.0959	0.0902	0.1945	0.0696	0.0778	0.0820	0.0766	0.0564	0.0679	0.0746	0.3404	0.3683
	Costa Rica	-0.0633	-0.1152	-0.1657	-0.2484	-0.3189	0.0796*	-0.1572***	0.2214	0.1034***	0.1110***	0.0503	-0.0031	0.0576*	-0.0296	-0.1760	0.0140	0.6400***
		0.1747	0.1814	0.2174	0.1955	0.2081	0.0472	0.0277	0.1396	0.0341	0.0432	0.0418	0.0409	0.0313	0.0337	0.0293	0.1758	0.1335
	ROW	0.8189	1.0605**	-0.6628	1.8572***	-0.9443	0.2261	-0.2909***	0.8728***	-0.8972***	-0.0941	0.6354***	-0.1486	0.0779	-0.1222	-0.2599***	-1.3201**	-0.8087**
		0.6181	0.5482	0.7130	0.6010	0.6496	0.1830	0.0836	0.2878	0.2018	0.1633	0.1793	0.1663	0.1336	0.1235	0.0820	0.7565	0.3648
papaya	Brazil	21.4552	-2.7999	1.6559	27.1787	-42.0564***	1.5914	-0.0939	9.2115***	-0.9249	-2.2477	1.4464	5.3062***	0.1042	-1.1229	-2.8986***	-8.9039	-6.9011
		7.3473	6.7065	8.2627	7.0922	7.9391	2.0027	0.9185	3.5862	1.6060	2.6772	1.9657	1.9093	1.5137	1.3908	0.9284	8.4493	4.2834
	Mexico	-0.6886	1.2773***	-1.6155***	0.4193	0.7506	0.3633***	-0.0913	0.2479	0.3709***	0.0859	-0.0266	-0.0380	0.0852	-0.1945**	-0.2066***	-0.4113	-0.3280
		0.4396	0.3851	0.5247	0.4213	0.4804	0.1408	0.0574	0.2058	0.1047	0.1167	0.1853	0.1211	0.0960	0.0891	0.0593	0.6090	0.2618
	ROW	-4.0459**	3.1015**	3.2022*	-0.0293	-0.1689	0.1561	-0.1151	-0.0589	-0.3342	1.2133***	-0.1461	-1.1615*	-0.1051	-0.5163	0.1466	1.8594	-2.9978***
		1.6127	1.4012	1.7887	1.5465	1.7397	0.4602	0.2068	0.7760	0.3741	0.4366	0.4663	0.6067	0.3625	0.3391	0.2101	1.9538	0.9173
Mangoes/Guavas	Ecuador	-9.6088***	-1.3296	2.1827	3.5768**	3.7372*	-0.4304	-0.2871	1.5851	0.2541	0.0346	0.4760	-0.1524	-1.2391**	0.3335	1.1650***	0.1226	-0.4201
		1.9269	1.6128	2.1985	1.7843	2.0251	0.5301	0.2208	0.8612	0.4356	0.5021	0.5360	0.5259	0.5785	0.3807	0.2200	2.3558	0.9511
	Guatemala	0.5221	-5.6778	-6.3369	-9.7638*	3.2663	-3.0289*	0.8669	-2.3076	-1.1274	-1.053	-3.0725**	-2.1179	-0.6784	2.2492	-2.0131**	7.6594	20.9924***
		5.0170	4.8551	5.9128	5.1163	5.6685	1.5499	0.7516	2.6205	1.1390	1.3046	1.4080	1.3911	1.6358	1.3791	0.9102	5.9315	3.7293
	Mexico	0.7158***	0.7067***	0.5984**	-1.5111**	0.4973*	-0.0307	0.0600**	-0.8007***	-0.1401***	-0.1589	-0.19073***	0.0351	0.1925***	-0.1176**	-1.6073***	-0.2311	1.9823***
		0.2035	0.2441	0.2686	0.2407	0.2590	0.0710	0.0483	0.1331	0.0442	0.0509	0.0548	0.0504	0.0363	0.0532	0.0822	0.2226	0.2788
	ROW	-4.3618	-7.5027***	5.4765	-0.7901	-5.7684**	-1.2693	-0.4008	0.1099	-1.2301*	-0.8438	-0.6564	0.7706	0.0350	0.7738	-0.3995	9.1541**	6.9030***
		3.0503	2.6425	3.5633	2.9232	3.4031	1.1038	0.3806	1.3825	0.7049	0.8007	0.9720	0.8097	0.6730	0.5992	0.3849	5.0216	2.1638
Other Fruits	World	0.0559**	0.1870***	0.1061***	0.1117***	0.0155	-0.0378***	0.0081	0.0789	-0.0118**	-0.0103	-0.0082	-0.0195***	-0.0019	0.0332***	0.0537***	0.1082***	-0.6696***
		0.0246	0.0325	0.0358	0.0293	0.0317	0.0084	0.0065	0.0165	0.0053	0.0064	0.0066	0.0060	0.0043	0.0059	0.0076	0.0339	0.0517

Below the estimated elasticities, are the respective standard errors and *, **, and *** are represent significance at the 10 percent, 5 percent and 1 percent levels, respectively. Significant substitute and complementary goods are marked by red and blue colors respectively..

Conclusions

A source-differentiated AIDS model is utilized to analyze the U.S. demand for tropical fresh fruits and to determine demand relationships of the leading U.S. tropical fresh fruit sources. The fresh fruits chosen for the study include fresh fruit imports of bananas, pineapples, papaya, mangoes/guavas, and other fresh fruit imports. The selected sources of bananas are Colombia, Costa Rica, Ecuador, Guatemala, and the ROW. Fresh pineapple sources are Mexico, Honduras, Costa Rica, and the ROW. Papaya sources are identified as Mexico, Brazil, and the ROW, while mangoes sources are Mexico, Guatemala, Ecuador, and the Row. For completeness, all the other fresh fruit imports are included. In total, sixteen (16) import share equations are formulated.

Although the data showed nonstationarity properties, an attempt to estimate a dynamic AIDS model proved futile, due to degrees of freedom limitations. A static AIDS model with lagged prices and shares was used instead. Endogeneity tests also showed that simultaneity exists in some of the prices and expenditures, justifying the use of an iterative 3SLS estimation method.

Results show that most of the source-differentiated fresh fruits expenditure shares are significant, positive, and very elastic implying that consumer incomes are a major determinant of tropical fresh fruit import demand. With the exception of bananas sources, tropical fresh fruits are found to be luxury commodities. For bananas, the expenditure elasticities estimates show that U.S. consumers prefer Guatemalan and Costa Rican bananas to the other sources. With regard to pineapples, Costa Rican, the ROW, and Honduras produced fruits are preferred in that order. Among mango sources, U.S. consumers have strong preference for ROW, Ecuador, and Mexican produced mangoes over Guatemalan mangoes. Papayas from the ROW are the most preferred.

A competitive relationship exists between bananas from Ecuador and Colombia, Ecuador and Costa Rica, and the ROW and Colombia, Costa Rica, and Ecuador. Surprisingly, bananas from Costa Rica and Colombia and from Guatemala and Ecuador are the only complementary commodities within the group. Bananas are also shown to be facing a lot of competition from the other tropical fresh fruits, particularly most pineapple and mango sources, as well as from all the other fresh fruit imports.

Strong competitive relations exist between papayas from Brazil and the ROW, pineapples from Costa Rica and Mexico and those from Costa Rica and the ROW, and mangoes from Mexico and Ecuador. Complementary relationships also exist between Guatemala and Mexican mangoes and pineapples from Honduras and Costa Rica and the ROW.

The findings from this study have some crucial implications for the countries that supply the U.S. with these tropical fresh fruits. The countries of origin might be interested in finding out by how much they could increase their market share in the U.S. and especially what might be the impact of price changes of their commodity. For example, Mexico is the leading supplier of mangoes/guavas to the United States, but, since 2000, it has been losing its market share to Ecuador and the ROW. Mexico could utilize price competition strategies to retain and regain its U.S. mango market share. Based on our price elasticity of demand estimates, if Mexico reduces the price of its mangoes prices by 1 percent, its mango expenditure share in the U.S. will increase by 1.6073 percent. As a result, Ecuador, which is its sole competitor in the U.S. mango market, would lose 1.1650 percent of U.S. mango expenditure share. Mexico would also gain 0.2066 percent of the U.S. papaya expenditure share from this action, because its mangoes and papayas are significant complementary goods. Mexico's pricing decision would further negatively impact U.S. expenditure shares of banana supplying countries except for Guatemala as they are significant substitutes. However, Mexico is not a major player in the banana market in the U.S. and has nothing to lose. Similarly, Colombia, Costa Rica, and Ecuador can utilize price competition in the banana market to capture more market share.

Based on the expenditure, own-price elasticities, and cross-price elasticities, countries which supply mangoes/guavas and papayas appear to be more capable of benefiting from price competition. Despite the fact that some of these results differed from our expectations, the study provides source-differentiated elasticity estimates for U.S. fresh fruit imports for many topical fruits, such as mangoes, papaya, and pineapples, which are unavailable in the existing literature. These results provide important market information to source/origin countries and the main tropical fruit trade players in those countries.

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