



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

U.S. Demand for Fresh Fruit and Vegetable Imports

Kilungu Nzaku, Jack E. Houston, and Esendugue Greg Fonsah

U.S. demand for fresh fruits and vegetables has been on the rise since the 1970s, due to increased purchasing power, changing consumer perceptions of and habits toward better health, and a fast-growing population of immigrants accustomed to fresh-produce diets (Huang and Huang 2007, Lucier, Pollack, and Perez 1997; Wells and Buzby 2008; Pollack 2001). Climate and farm labor supply hamper U.S. producers' ability to respond to the increased demand. As a result, the U.S. increasingly depends on imports from NAFTA, banana-exporting countries, and the Southern Hemisphere to satisfy the demand for fresh produce (Huang and Huang 2007, Fonsah et al. 2007). These studies analyze the dynamic (monthly) demand for fresh, primarily tropical, fruit and vegetable imports into the U.S. We also explore the demand relationships between the fresh fruits and vegetables from various exporting entities using a source-differentiated Almost Ideal Demand System approach (Deaton and Muellbauer 1980, 1993).

We first estimated the demand for tropical fresh fruits using a dynamic AIDS model. The fresh fruits chosen for the study include bananas, pineapples, papayas, mangoes/guavas, grapes, avocados, and other fresh fruit imports. Non-stationarity and cointegration in the data series justified an error correction specification of the AIDS model (Banerjee, Dolado, and Smith 1986, Karagiannis, Katranidis, and Velentzas 2000). The study findings show that NAFTA has not been influential in tropical fresh fruit imports, perhaps because these commodities originate largely from non-NAFTA countries, with the exception of mangoes. All the fresh fruit import expenditure shares positively and significantly respond to real income/expenditures, implying that consumer income is a major determinant of U.S. tropical fresh fruit imports.

Fresh grapes and other fresh fruit imports are found to be luxury commodities, while bananas are staples, as has been shown in the existing literature (You, Epperson, and Huang 1996, Huang and Lin 1987). Papayas and mangoes/guavas are price elastic, whereas bananas, pineapples, U.S. grapes, and other fruit imports are price inelastic. Imported avocados appeared to be substitutes for bananas, papayas, mangoes/guavas, and fresh grape imports. Fresh grape imports are also significant substitutes for domestic grapes, implying that besides supplementing supply during U.S. production off-season in winter, the imported fresh grapes compete with U.S. produced grapes in summer and fall seasons. This is understandable, since fresh grape imports come mainly from Chile and Mexico; they are produced year-round in Chile and some parts of Mexico. Other significant substitutes include bananas and mangoes/guavas, pineapples and papayas, and mangoes/guavas and grape imports. Complementary fresh fruits include bananas and

grape imports, avocados and other fruit imports and U.S. grapes. To some extent, these findings reinforce known fresh fruit consumption patterns. For example, bananas and fresh grapes are both often eaten as snacks and can be consumed together.

A dynamic source-differentiated AIDS model estimation of selected fresh vegetables included fresh tomatoes, peppers, cucumbers, and asparagus. The origin of the fresh vegetables is categorized into U.S. domestic source and total imports. All the data series were found to be nonstationary and cointegrated, and therefore an ECM-AIDS model was used. Most fresh vegetable imports were shown to be more price elastic than their domestic vegetable cohort. Cucumbers and asparagus are shown to be price elastic, and all the fresh vegetables were found to be responsive to real expenditure changes, as expected. Most of the U.S. fresh vegetable imports were shown to significantly compete with domestic fresh vegetables, and in particular with tomatoes, peppers, and cucumbers. Asparagus, on the other hand, show no significant relationship between imports and U.S.-produced commodities. This implies that asparagus is the only fresh vegetable commodity whose imports are independent of local produce.

Finally, a source-differentiated AIDS model is

Nzaku is Postdoctoral Researcher, Center for Business and Economic Research, University of Alabama, Tuscaloosa. Houston is Professor, Department of Agricultural and Applied Economics, University of Georgia, Athens. Fonsah is Associate Professor, Department of Agricultural and Applied Economics, University of Georgia, Tifton.

used to analyze the relationships between U.S. tropical fresh fruit imports from various sources. Bananas, pineapples, papaya, mangoes/guavas, and other fresh fruit imports are selected and their respective sources differentiated by the top countries of origin. Due to endogeneity in expenditure and prices, an iterative 3SLS method of estimation is used. Results show that most of the source-differentiated tropical fresh fruit imports are luxury commodities, as their expenditure elasticities are very elastic, except for bananas, which appear to be a staple. Within commodity groups, U.S. consumers have a preference for Guatemalan bananas, Costa Rican pineapples, and rest of world (ROW) papayas and mangoes over commodities from other sources. Honduran pineapples, Mexican papayas, Ecuadorian and Mexican mangoes/guavas, and other fruit imports are also highly sought after, as their expenditure elasticities are greater than one in magnitude.

The cross-price elasticities from the source-differentiated AIDS model also show a strong competitive relationship between bananas from Ecuador and those from Colombia, Costa Rica, and the ROW. Costa Rican bananas also have a competitive relationship with those from the ROW. Bananas from the ROW also show a competitive relationship with those from Costa Rica and Ecuador. Bananas appear to be facing a lot of competition from the other tropical fresh fruits, mainly mangoes/guavas and pineapples, which is evident from the positive and significant cross-price elasticities. This is consistent with our expectations, due to the declining banana import share, which is documented in recent literature (HASS 2001; Fonsah, Krewer, and Rieger 2004; Fonsah et al. 2007, Huang and Huang 2007).

Results also show that papayas from Brazil and the ROW, pineapples from Costa Rica and Mexico and from Costa Rica and the ROW, and mangoes/guavas from Mexico and Ecuador are substitutes and therefore are competitors. Complementary relationships are found to exist between mangoes/guavas from Guatemalan and Mexico and among pineapples from Honduras, Costa Rica, and the ROW. Other commodities that are shown to have complementary relationships include bananas from Costa Rica and Colombia and those from Guatemala and Ecuador.

Elasticity estimates from the error correction ver-

sion of the AIDS model are compared to estimates from a seasonal trigonometric AIDS model for tropical fresh fruits and vegetable imports. Table 1 presents income/expenditure and own-price elasticity estimates of a seasonal trigonometric and error correction versions of the AIDS model for tropical fresh fruit and vegetable imports. Statistically significant expenditure/income and own-price elasticities of demand are shown in bold. By magnitude, estimates of own-price elasticities of demand for bananas, pineapples, avocados, and peppers are very close in both models, whereas there are substantive differences in the expenditure elasticity estimates.

Table 2 shows the demand relationships between tropical fresh fruits and vegetables based on the seasonal trigonometric and error correction estimates; that is, it shows whether fresh produce commodities are statistically significant substitutes or complementary goods. Significant substitutes in the trigonometric and error correction AIDS models are denoted 1_s and 2_s , respectfully. The designations 1_c and 2_c are used to represent significant complementary commodities in the trigonometric and error correction AIDS model versions, respectively. Results show imports of papayas and pineapples and of avocados and pineapples to be significant substitute commodities in both the error correction and trigonometric AIDS models, while those of tomatoes and asparagus are complementary commodities.

Overall, NAFTA has no apparent impact on imported fresh fruits, because most originate from tropical regions. But NAFTA does impact fresh vegetable imports. Our results confirm that most tropical fresh fruits are luxury commodities, while bananas are a staple food. Bananas face strong competition from other tropical fresh fruits. With the exception of asparagus, all the fresh vegetable imports significantly compete with domestically grown fresh vegetables. These findings support prior studies, particularly on fierce competition between Florida tomatoes and imports from Mexico (VanSickle 1996; VanSickle, Evans, and Emerson 2003). Fresh imported grapes also directly compete with U.S.-produced fresh grapes instead of complementing each other seasonally. Results also indicated that U.S. consumers have a preference for tropical fresh fruits from various sources due to quality differences. For example, Guatemalan ba-

Table 1. Elasticity Estimates of a Seasonal Trigonometric and Error Correction AIDS Model for Fresh Fruits and Vegetable Imports, 1989–2008.

		Trig. model	ECM fruits	ECM veg.	Trig. model	ECM fruits	ECM veg.
		<i>Expenditure elasticities</i>			<i>Own-price elasticities</i>		
Fruits	BANANA _{IM}	1.1056	0.2491		−0.0922	−0.0952	
	PINEAPPLE _{IM}	0.7077	0.4179		−0.2049	−0.3883	
	PAPAYA _{IM}	0.8391	0.4612		−0.1121	−1.3211	
	MANGO _{IM}	0.5468	0.0810		−0.5862	−1.3869	
	GRAPES _{IM}	0.9533	3.3193		0.2391	−0.6062	
	AVOCADO _{IM}	1.1387	0.7998		−0.8499	−0.8524	
	OTHER FRUIT _{IM})		1.2355			−0.4212	
	GRAPES _{US}		0.7884			−0.3758	
Vegetables	TOMATO _{IM}	1.0824		0.1111	−0.9194		−0.5317
	PEPPER _{IM}	0.8000		0.2692	−0.6774		−0.6284
	CUCUMBER _{IM}	0.8931		0.3749	−0.6005		−1.0987
	ASPARAGUS _{IM}	1.0531		0.1844	−0.1237		−0.9003
	OTHER VEG _{IM}			0.4086			−0.5197
	TOMATO _{US}			1.5056			−0.4505
	PEPPER _{US}			0.9905			0.0326
	CUCUMBER _{US}			0.4825			−0.2366
	ASPARAGUS _{US}			1.5193			−0.7084

Statistically significant estimates at 1, 5, or 10 percent levels are shown in bold. IM = Imports. US = U.S. domestic supply.

nanas, Costa Rican pineapples, and ROW papayas and mangoes/guavas are preferred over the same commodities from competing countries.

The findings from this study provide some insights into demand relationships for fresh fruit and vegetable imports in the U.S. A major policy implication of this study is that the U.S. may need to re-examine the impact of fresh vegetable imports on the domestic fresh produce industry, as they are not contra-seasonal and pose a threat to domestic producers. International fresh fruit and vegetable trade players and countries of origin could use the results from this study to determine their export promotion strategies in the U.S. fresh produce market based on their commodity's expenditure, own-price, and cross-price elasticities.

The key market players in fresh fruit and vegetable trade and the countries of origin for these commodities might use the findings in determining how much they could increase their market share if price competition is a viable option. The U.S. might also find the results useful in deciding which fresh produce commodities need assistance in terms of research and infrastructure development to enhance the ability of the U.S. fresh fruit and vegetable industry to fairly compete with imports and to identify the exotic fresh fruits that are most in demand.

A major limitation of these studies was the lack of data on monthly consumption of domestically produced fresh fruits and vegetables. Monthly fresh fruit and vegetable shipments are available from the Agricultural Marketing Service and serve as proxies

Table 2. Summary of Cross-Price Elasticities of Demand of Fresh Fruit and Vegetable Imports.

		Fruits								Vegetables								
		BANA _{IM}	PINEA _{IM}	PAPA _{IM}	MANG _{IM}	GRAP _{IM}	AVOC _{IM}	OTHER FRUIT _{IM}	GRAPE _{US}	TOMA _{IM}	PEPP _{IM}	CUCU _{IM}	ASPA _{IM}	OTHER VEG _{IM}	TOMA _{US}	PEPP _{US}	CUCU _{US}	ASPA _{US}
Fruits	BANANA _{IM}			1 _C	2 _S	2 _C	2 _S		2 _S	1 _S	1 _S		1 _C					
	PINEAPPL _{IM}			1 _S 2 _S			1 _S 2 _S						1 _S					
	PAPAYA _{IM}				1 _C		2 _S						1 _S					
	MANGO _{IM}					2 _S	2 _S	2 _S		1 _S			1 _S					
	GRAPES _{IM}						2 _S	2 _S	2 _S									
	AVOCAD _{IM}								2 _C		1 _C							
	OTHER FRUIT _{IM}																	
	GRAPES _{US}																	
Vegetables	TOMATO _{IM}										2 _C		1 _C 2 _C	2 _C	2 _S		2 _C	
	PEPPER _{IM}													2 _S	2 _S	2 _S		
	CUCUM _{IM}												2 _S		2 _S		2 _S	
	ASPAR _{IM}													2 _S	2 _S		2 _S	
	O T H E R VEG _{IM}																	2 _C
	TOMATO _{US}																	1 _C
	PEPPER _{US}																	
	CUCUM _{US}																	
	ASPARA _{US}																	

of the U.S. monthly consumption. Another limitation is the dominance of U.S. fresh produce sector by a few multinational companies, which decide where to produce and ship each commodity. Thus the source-differentiation is not purely a consumer decision. Also, different varieties of tomatoes, pineapples, papayas, mangoes, and, in essence, all the fresh produce commodities fetch different prices due to quality differences, a consideration that was not captured in our study.

References

- Banerjee, A., J. Dolado, and G. Smith. 1986. "Exploring equilibrium relationships in econometrics through static models: some Monte Carlo evidence." *Oxford Bulletin of Economics and Statistics* 48:253–278.
- Deaton, A. and J. Muellbauer. 1980. 1993. *Economics and Consumer Behavior*. London: Cambridge University Press.

- . “An Almost Ideal Demand System.” *The American Economic Review* 70(3):312–326.
- Fonsah, E. G., G. Krewer, and M. Rieger. 2004. “Banana Cultivar Trials for Fruit Production, Ornamental-Landscape Use, and Ornamental-Nursery Production in South Georgia.” *Journal of Food Distribution Research* 35(1):86–92.
- Fonsah, E. G., G. Krewer, R. Wallace, and B. Mullinix. 2007. “Banana Trials: A Potential Niche and Ethnic Market in Georgia.” *Journal of Food Distribution Research* 38(3):14–21.
- Huang, K. S. and B. H. Lin. 1987. “Estimation of Food Demand and Nutrient Elasticity from Household Survey Data.” Technical Bulletin Number 1887. United States Department of Agriculture, Economic Research Service.
- Huang, S. and K. Huang. 2007. “Increased U.S. imports of Fresh Fruit and Vegetables.” *FTS-328-01* September. United States Department of Agriculture, Economic Research Service.
- Hawaii Agricultural Statistics Service (HASS). 2001. “Hawaii Fruits Annual Summary. Monthly Banana.” Hawaii Department of Agriculture, National Agricultural Statistics Services.
- Karagiannis, G., S. Katranidis, and K. Velentzas. 2000. “An Error Correction Almost Ideal Demand System for Meat in Greece.” *Agricultural Economics* 22:29–35.
- Lucier, G., S. Pollack, and A. Perez. 1997. “Import Penetration in the U.S. Fruit and Vegetable Industry.” United States Department of Agriculture, Economic Research Service.
- Pollack, S. 2001. “Consumer Demand for Fruit and Vegetables: The US Example.” Chapter 6. In A. Regmi, ed., *Changing Structure of Global Food Consumption and Trade*. U.S. Department of Agriculture, Economic Research Service. Agricultural and Trade Report, WRS-01-1.
- VanSickle, J. J. 1996. “A Compromise in the Fresh Tomato Trade Dispute.” *Florida Journal of International Law* 11:399.
- VanSickle, J. J., E. A. Evans, and R. D. Emerson. 2003. “US–Canadian Tomato Wars: An Economist Tries to Make Sense Out of Recent Antidumping Suits.” *Journal of Agricultural and Applied Economics* 35:283–296.
- Wells, F. H. and J. C. Buzby. 2008. “Dietary Assessment of Major Trends in U.S. Food Consumption, 1970–2005.” United States Department of Agriculture, Economic Research Service.
- You, Z., J. E. Epperson, and C. L. Huang. 1996. “A Composite System Demand Analysis for Fresh Fruits and Vegetables in the United States.” *Journal of Food Distribution Research* 27:11–22.