Competiveness of Latin American Exports in the U.S. Banana Market[1]

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Abstract

U.S. banana demand differentiated by country of origin is estimated using the generalized dynamic Rotterdam model. Results indicate that dynamic factors play a significant role in determining the allocation of U.S. banana expenditures across exporting sources. Of particular interest is Guatemala's increased share and Costa Rica's decreased share of the U.S. banana market. A number of factors explained why Guatemala replaced Costa Rica as the leading U.S. supplier in 2007. (1) Guatemala is the least expensive source on average. (2) Habit persistence, adjustment costs, and other dynamic factors favor Guatemala's exports. (3) Given increases in the relative price of Costa Rica's bananas, the price competition between Costa Rica and Guatemala is highly significant. (4) Bananas from Costa Rica are highly responsive to own-price while imports from Guatemala are more price-inelastic. (5) Heavy rains and fluctuating temperatures in Costa Rica have decreased banana production and exports.

JEL Classifications: F14, Q11, Q13, Q17

Key words: bananas, imports, demand, Latin America, United States

1. Introduction

The United States ranks first among banana importing countries. In 2009, U.S. banana imports equaled $1.9 billion, accounting for 20% of global banana trade. Bananas are also the leading fruit imported by the United States, and due to negligible domestic production, imports account for nearly all of U.S. consumption (U.S. Department of Agriculture, 2010; UN Comtrade, 2010).

About 95% of U.S. fresh banana imports come from five countries: Guatemala, Ecuador, Costa Rica, Colombia, and Honduras (table 1). In 2000, Costa Rica was the leading U.S.

supplier accounting for 31.4% of the U.S. banana market, while Guatemala was the third leading supplier accounting for 17.6%. However, during the period 2000–09 there was a significant reversal in market share for these two countries. Although the value of U.S. banana imports has increased since 2000, particularly from 2006 to 2009 where imports grew by 32%, imports from Costa Rica have steadily declined and its share of the U.S. market has fallen to 14.5%. During this same period, Guatemala's share of the U.S. market increased to 29.6%, making it the leading U.S. supplier.

[Place Table 1 approximately here]

The emergence of Guatemala and Costa Rica's decline is to some extent due to the recent changes in total banana exports for each country. From 2000 to 2005, Guatemala's total exports increased by 41%, while Costa Rica's total exports decreased by 15%. Unlike Guatemala, Costa Rica relies less on the United States for export disappearance. The United States accounts for about 80% to 90% of Guatemala's fresh banana exports. In contrast, EU countries and Russia account for about half of all banana exports from Costa Rica (FAOSTAT, 2010).

This study examines the factors that determine U.S. fresh banana imports and assesses the competitiveness of the countries that supply fresh bananas to the United States. Of particular interest is how factors such as import prices, U.S. banana expenditures, habit persistence, and import trends explain changes in the allocation of U.S. banana expenditures across supplying countries. This is important because the banana sector is a major source of foreign exchange for the Central and South American countries that supply fresh bananas to the United States. Furthermore, there is a strong connection between banana-generated income and household food security where changes in export volume can affect workers in the primary sector, as well as supporting sectors. For instance, Haines, Cashin and Mlachila (2010) found that banana trade

between the European Union (EU) and Caribbean countries had considerable macroeconomic impacts, especially on economic growth in Caribbean countries. In 2006, bananas accounted for 9.3% of export earnings in Ecuador, 7.7% in Costa Rica, 6.8% in Honduras and 5.9% in Guatemala (UNCTAD, 2010). The economic consequences of decreased U.S. demand could be quite substantial for those banana-producing countries that depend on the U.S. market for export disappearance.

The generalized dynamic Rotterdam model (Bushehri, 2003) is used to estimate U.S. banana demand differentiated by exporting source while accounting for noninstantaneous adjustments in import demand. The import demand estimates are then used to derive short-run and long-run expenditure and price elasticities. Estimation results are used to explain how Guatemala replaced Costa Rica as the leading U.S. supplier in 2007.

Although bananas are fairly homogeneous across exporting countries it is not uncommon for a country to import a homogeneous product from multiple sources and for import preferences to be differentiated by source (Wolak and Kolstad, 1991). Source-differentiation can results from a number of factors such as a country's reputation for a quality product, trade history, reliability and consistency, and political issues tied to trade (Lopez, Pagoulatos, and Gonzalez, 2006; Zhou and Novakovic, 1996). Importers may view homogeneous products as source-differentiated given risk perceptions about exporting counties where the allocation of total imports across countries is a way to minimize import risk (Wolak and Kolstad, 1991).

Several studies have examined fruit demand and trade in a source-differentiated context. Seale, Sparks, and Buxton (1992) and Richards, Ispelen, and Kagan (1997) analyzed the demand for fresh apples differentiated by source and assessed the competitiveness of U.S. apple exports in selected international markets. Andayani and Tilley (1997) used the almost ideal demand

system to estimate source-differentiated demand for apples, oranges, grapes, and other fruit in Indonesia, and Sparks (1992) estimated the demand for source-differentiated oranges in the EU, Singapore, Japan, Canada, and Hong Kong. While the scholarly literature on world banana trade is quite extensive, econometric studies highlighting the importance of source are absent from the literature. Furthermore, owing to prominent changes in EU banana policy, most studies of the banana trade have focused on fresh banana imports by the EU. For examples see Anania (2006); Guyomard, Laroche, and Le Mouel (1999); and Deodhar and Sheldon (1995).

2. Background

Banana production and trade is characterized by high levels of regional concentration. The top 10 banana-producing countries accounted for more than 75% of world banana production in 2007, with India, China, the Philippines, Brazil, and Ecuador being among the world's major producers. In the last quarter century, Latin America's dominance has given way to increased production in Asian countries. In the 1970s, Latin America accounted for more than half of world production versus about one-third for Asian countries. However, Asia's production increased during the 1990s and 2000s reaching about 60% of world production in 2007. Latin America now accounts for about one-third of world production (UNCTAD, 2010).

Latin American countries still account for a major share of global banana trade. In 2007 for instance, Latin America accounted for only 31% of world production but 72% of world exports (UNCTAD, 2010; FAOSTAT, 2010). The major U.S. suppliers, Ecuador, Costa Rica, Colombia, Guatemala and Honduras, ranked first, second, fourth, fifth and seventh in the world, respectively, accounting for about two-thirds of world banana trade in 2009. Ecuador alone accounted for 28% of world banana trade (UN Comtrade, 2010).

The United States and EU are major export destinations for Latin America's banana exports. While relative proximity contributes to the importance of the U.S. market for export disappearance, some Latin American countries are relatively less dependent on the United States than others. In 2009, Russia and Italy purchased about 40% of Ecuador's banana exports while the United States accounted for 22%. Germany and Belgium also accounted for a significant share of Ecuador's banana exports at about 10% and 6%, respectively. For Costa Rica, the United States has become relatively less important overtime. In 2001, the United States accounted for 58% of Cost Rica's banana exports. By 2009, the United States accounted for a smaller percent (46%) while the EU accounted for 51%. Contrastingly, the United States accounts for over 85% of Guatemala's banana exports (UN Comtrade, 2010).

Three multinational corporations—Chiquita Brands International, Dole Food Company, Inc., and Fresh Del Monte Produce Inc. (hereafter referred to as the "Top 3")—are responsible for marketing about 70% of the world's banana exports (UNCTAD, 2009; personal communiqué, 2010). Each of the Top 3 owns or part owns banana plantations in Central and South America and other banana-producing regions in the world. Within Central and South America, Chiquita produces bananas in Colombia, Costa Rica, Ecuador, Guatemala, and Honduras (Chiquita Brands International, 2010); Dole owns banana plantations in Costa Rica, Ecuador, and Honduras (Dole Food Company, 2010: 41); Fresh Del Monte produces bananas in Costa Rica, Guatemala, and Brazil (Fresh Del Monte Produce Inc., 2010). In addition, the Top 3 package fruit under their respective logos purchased from national banana companies, cooperatives, and individual growers as long as it meets their quality specifications (personal communiqué, 2010; CIRAD, 2007).

After the Top 3, the next two leading banana marketers are Exportadora Bananera Noboa S.A., an Ecuadorean firm, and Fyffe's, an Irish company. Rather than owning its own plantations, Fyffe's purchases bananas on a yearly contract basis from small farmers, cooperatives, and national producers and then markets them in Europe and the United States. Currently, Fyffe's purchases fruit from Costa Rica, Ecuador, Honduras, Colombia, and Belize. National banana companies such as Colombia's Uniban-Turbana market almost all of the remainder of the world's banana exports.

It would be a mistake to view the Top 3 as a homogeneous group. Each of the Top 3 has a unique corporate history that has led to a unique business structure. Chiquita Brands International emerged from a prearranged bankruptcy restructuring in 2002; Dole Food Company, Inc. was split off from the firm's former real estate operations in 1995; and Fresh Del Monte Produce was acquired by the IAT Group, an international produce company, in 1996. Moreover, the geographic locations of the Big 3's production, marketing, and sourcing operations give each firm a particular set of advantages and disadvantages. For example, flooding has affected Fresh Del Monte Produce's banana operations in Guatemala in 2010 and in Costa Rica in 2007.

3. Dynamic Import Demand Model

Due to habit persistence and/or adjustment costs, quantity demanded may not be fully responsive to changes in exogenous variables in the short-run but partially adjust over several periods (Pollak, 1970; Sexauer, 1977). To account for the lagged responsiveness in U.S. fresh banana imports, the generalized dynamic Rotterdam model (Bushehri, 2003) is used in estimation. To limit the analysis to fresh bananas, a multistage budgeting process is assumed where

expenditures are first allocated to the product group *fresh bananas*. Then, banana expenditures are allocated across the banana exporting countries. It is further assumed that fresh bananas and other product groups are blockwise dependent, which implies that the utility interaction between bananas and other products is independent of the exporting country or product origin. Theil and Clements (1987: 180-182) show that blockwise dependence is sufficient for the existence of a conditional differential demand system limited to goods within a product group.

Let q and p denote the quantity and price of bananas, respectively, h denote a measure of dynamic behavior or habit persistence, i and j denote the product origin (exporting country), n denote the number of source countries, and x denote total expenditures where $x = \sum_{i=1}^{n} p_i q_i$. Following Bushehri (2003), the dynamic Rotterdam model is specified as

$$w_i \frac{\dot{q}_i}{q_i(t)} = \sum_{j=1}^{n} w_i \phi_{ij} \frac{\dot{h}_j}{h_j(t)} + w_i \eta_i \left[\frac{\dot{x}}{x(t)} - \sum_{j=1}^{n} w_j \frac{\dot{p}_j}{p(t)} \right] + \sum_{j=1}^{n} w_i \eta_{ij}^{*} \frac{\dot{p}_j}{p(t)}. \qquad (1)$$

Note that for any variable y, $\dot{y} = \mathrm{d}y(t)/\mathrm{d}t$. w_i is the share of total expenditures allocated to bananas from the ith country ($w_i = p_i q_i / \sum_{i=1}^{n} p_i q_i$). ϕ_{ij} can be defined as the responsiveness of quantity demanded for good i to changes in past imports of good j. η_i is the expenditure elasticity, and η_{ij}^{*} is the compensated price elasticity. Without the dynamic adjustment term $\sum_j w_i \phi_{ij} \dot{h}_j / h_j(t)$, equation (1) is similar to the absolute price version of the Rotterdam model found in Theil (1980) where the term in brackets is the change in real aggregate expenditures and the last term denotes the impact of price changes on the quantity imported.

The empirical form of equation (1) requires that continuous time changes be replaced with discrete time changes. Theil (1980) and Bushehri (2003) suggest log differences. Since monthly data are used in the analysis and U.S. banana imports are seasonal, we use the 12-period

log difference to correct for seasonal variation (Lee, 1988). Therefore, the change in quantity and price is approximated as follows:

$\Delta q_t = \log q_t - \log q_{t-12} \approx \dot{q} / q(t)$ and $\Delta p_t = \log p_t - \log p_{t-12} \approx \dot{p} / p(t)$.

The term in brackets in equation (1) is equal to the Divisia volume index, which is a measure of real aggregate expenditures (Theil 1980). We replace this term with a discrete measure of the Divisia volume index ΔQ_t, where

$$\Delta Q_t = \sum_{i=1}^{n} w_i \Delta q_{it} = \Delta x_t - \sum_{j=1}^{n} w_j \Delta p_j \approx \dot{x} / x(t) - \sum_{j=1}^{n} w_j (\dot{p}_j / p(t)) . \quad (2)$$

Specific to this study, ΔQ_t is a measure of change in real aggregate expenditures on fresh banana imports.

Following Bushehri (2003), the dynamic specification used for discrete time periods is

$$\sum_{j=1}^{n} \phi_{ij} \frac{\dot{h}_j}{h_j(t)} = \alpha_i + \sum_{k=1}^{p} \sum_{j=1}^{n} \alpha_{ijk} \Delta q_{jt-k} , \quad (3)$$

where $\sum_k \sum_j \alpha_{ijk} \Delta q_{jt-k}$ is a distributed lag of the quantities imported in log-difference form.

Given equations (1)–(3), the empirical specification of the dynamic Rotterdam model is expressed as

$$\bar{w}_{it} \Delta q_{it} = \gamma_i + \sum_{k=1}^{p} \sum_{j=1}^{n} \gamma_{ijk} \Delta q_{jt-k} + \theta_i \Delta Q_t + \sum_{j=1}^{n} \pi_{ij} \Delta p_{jt} + \varepsilon_{it} \quad (4)$$

where $\bar{w}_{it} = 0.5(w_{it} + w_{it-12})$; $\gamma_i = \bar{w}_{it} \alpha_i$; $\gamma_{ijk} = \bar{w}_{it} \alpha_{ijk}$; $\theta_i = \bar{w}_{it} \eta_i$; and $\pi_{ij} = \bar{w}_{it} \eta_{ij}^{*}$. γ_i, γ_{ijk}, θ_i, and π_{ij} are parameters to be estimated, and ε_{it} is a random disturbance term. Equation (4) states that the change in the quantity imported from country *i* weighted by the *i*th import share is a function of past imports from that country (and competing countries) q_{jt-k}, real expenditures on fresh bananas from all countries ΔQ_t, and individual import prices p_{jt}.

Demand theory requires the following parameter restrictions:

$\sum_i \gamma_i = 0$, $\sum_i \gamma_{ijk} = 0 \ \forall\, j$ and k, $\sum_i \theta_i = 1$, $\sum_i \pi_{ij} = 0$ (adding up);

$\sum_j \pi_{ij} = 0$ (homogeneity); $\pi_{ij} = \pi_{ji}$ (symmetry); and

$\mathbf{\Pi}_{n\times n} = \left[\pi_{ij}\right]$ is negative semidefinite.

Given the parameters in equation (4), the short-run conditional expenditure and compensated (Hicksian) price elasticities are respectively defined as $\theta_i / \overline{w}_i$ and $\pi_{ij} / \overline{w}_i$. The short-run uncompensated (Marshallian) price elasticity is defined as $\pi_{ij} / \overline{w}_i - \theta_i \overline{w}_j / \overline{w}_i$ (Seale, Sparks and Buxton, 1992). The long-run expenditure, Hicksian and Marshallian price elasticity are respectively defined as (Bushehri, 2003)

$$\eta_i^L = \frac{\theta_i}{\overline{w}_i - \left(\sum_k \gamma_{iik}\right)} \tag{5}$$

$$\eta_{ij}^{*L} = \frac{\pi_{ij}}{\overline{w}_i - \left(\sum_k \gamma_{iik}\right)} \tag{6}$$

$$\eta_{ij}^L = \frac{\pi_{ij}}{\overline{w}_i - \left(\sum_k \gamma_{iik}\right)} - \frac{\theta_i}{\overline{w}_i - \left(\sum_k \gamma_{iik}\right)} \overline{w}_j . \tag{7}$$

4. Data and Statistics

U.S. import data are provided by the U.S. Department of Agriculture, Foreign Agricultural Service, where banana imports are defined according to the Harmonized System classification 0803002020 *fresh bananas*. Plantains and dried bananas are not part of this category. Monthly import data (January 2000–March 2010) measured in kilograms and U.S. dollars are disaggregated for the following exporting countries: Colombia, Costa Rica, Ecuador, Guatemala,

Honduras, and the rest of the world (ROW). Import values are on a free-on-board (FOB) basis, excluding transportation costs, insurance, and custom duties. Unit values are used as proxies for import prices (U.S. dollars per kilogram).

Summary statistics for import prices, quantities, values, and expenditure shares are reported in Table 2. On average, the price of U.S. banana imports is relatively the same across exporting countries. While ROW prices ($0.354/kg) are somewhat higher compared with the other exporting countries, the price difference between the primary suppliers is at most $0.035/kg on average. Bananas from Colombia are the most expensive ($0.319/kg) followed by Honduras ($0.294), Costa Rica ($0.292), and Ecuador ($0.288). The least expensive source is Guatemala ($0.284). On average, Guatemala accounted for the largest share of the U.S. market (24.39%) during the period examined, followed by Ecuador (23.96%) and Costa Rica (23.80%). Colombia and Honduras accounted for 13.29% and 11.01%, respectively, and ROW accounted for 3.55%.

[Place Table 2 approximately here]

5. Empirical Results

The import demand system as specified by equation (4) was estimated using the LSQ procedure in TSP (version 5.0) which uses the generalized Gauss-Newton method to estimate the parameters in the system (Hall and Cummins, 2005). Likelihood ratio (LR) tests were used to determine the significance of homogeneity and symmetry. Following Brown and Lee (1992), LR tests were also used to determine the adjustment period (lag-length) since a dynamic model of lag-length k is nested within a model of lag-length k+1. Test results are reported in Table 3 and indicate that both homogeneity and symmetry failed to be rejected at any reasonable

significance level. Results also indicate that a lag-length of two months is optimal suggesting that it takes up to two months for U.S. banana imports to adjust fully to changes in expenditures and prices.

[Place Table 3 approximately here]

Partial adjustment estimates (lag effects) are reported in Table 4. The own-lag effects are presented along the diagonal; positive values indicate habit persistence and negative values suggest inventory adjustment behavior (Sexauer, 1977). Given that fresh bananas are highly perishable, it is not likely that importers maintain banana inventories on a monthly basis. Therefore we would expect the own-lag effects to be positive. Results show that all one-month own-lag effects are significant and positive suggesting that the responsiveness of imports to changes in prices and expenditures is not instantaneous and that present consumption has a positive effect on future consumption (habit effect), ceteris paribus. Additionally, positive own-lag effects may also be due to biological and institutional constraints resulting in partial adjustments in demand in the short-run (Marsh, 1991). For instance, contractual obligations between domestic retailers and exporting firms may lead to source-specific rigidities in the face of changing expenditures and relative prices.

The two-month own-lag effects are mostly insignificant with the exception of bananas from Guatemala and Honduras. The positive estimate for Guatemala (0.0672) suggests even greater responsiveness in the long-run. While the opposite is true for Honduras (-0.0174), the combined own-lag effect over the two periods is still positive.

[Place Table 4 approximately here]

The sign and magnitude of the cross-lag effects depend on the relationship between imports (substitutes versus complements) and the adjustment behavior of importers (habits

versus inventories). If bananas from any two countries are substitutes (complements) and unrelated to the other countries their cross-lag effect should be negative (positive) given habit formation behavior. Since banana imports from most sources are related to more than one competing country (Ecuador and ROW are the exception), we can only discuss the cross-lag effects in a ceteris paribus context. The two-month cross-lag effect of Guatemala on Costa Rica (-0.060) provides some insight into the market share reversal discussed in the introduction. The negative estimate suggests that increased imports from Guatemala have a negative effect on imports from Costa Rica, ceteris paribus. However, past imports from Costa Rica have no effect on imports from Guatemala.

Conditional demand estimates are reported in Table 5. Overall, the dynamic Rotterdam model performed reasonably well. Expenditures, prices and lagged quantities each explained a significant percent of the variation in import demand by source. Given that the model was estimated using log-differences, the constant term (γ_i) measures the trend in imports holding prices and expenditures constant where the average annual growth rate in the *i*th import can be approximated as $\gamma_i / \overline{w}_i \times 100$. The constant terms are significant for three countries: Costa Rica, Guatemala, and ROW. The negative estimate for Costa Rica (-0.0083) coupled with the positive estimate for Guatemala (0.0061) also explains the observed market share reversal from 2000 to 2009. During the period 2000–09, U.S. banana imports from Costa Rica in terms of volume fell by 8.2% per year on average, while imports from Guatemala increased by 6.0% per year on average. The constant estimate for Costa Rica indicates that of the 8.2% decrease, 3.5% is due to

trending factors, ceteris paribus. For Guatemala, of the 6.0% increase 2.5% is due to trending factors.[2]

All marginal share estimates or expenditure effects (θ_i) are positive and significant at the 0.01 level with the exception of ROW bananas which is significant at the 0.10 level. These estimates indicated how a dollar increase in aggregate banana expenditures (in real terms) is allocated across the supplying countries. Bananas from Costa Rica (0.301) and Guatemala (0.283) have the largest marginal share estimates. The marginal share estimates for Colombia (0.093), Ecuador (0.178), Honduras (0.129), and ROW (0.017) are significantly smaller.

[Place Table 5 approximately here]

Consistent with theory, the own-price effects (π_{ii}) are all negative which ensures that the matrix of price effects is negative semidefinite. However, the estimates for Costa Rica (-0.130), Honduras (-0.074), and ROW (-0.028) are the only own-price effects that are statistically significant. The cross-price effects indicate significant competition between Colombia and Ecuador (0.030), and Honduras (0.023). The cross-price effects for Costa Rica are 0.052 (Ecuador), 0.065 (Guatemala), 0.053 (Honduras), and 0.021 (ROW) indicating that bananas from every county except Colombia are substitutes for Costa Rican bananas in the U.S. market. There are also two significant complementary relationships, Colombia and Costa Rica (-0.060), and Ecuador and Guatemala (-0.050).

[2] The mean import share for Costa Rica and Guatemala is 0.238 and 0.244, respectively. Given the constants -0.0083 and 0.0061, the annual growth for Costa Rica and Guatemala holding prices and real aggregate expenditures constant is $-0.0083 \div 0.238 \times 100 = -3.487\%$ and $0.0061 \div 0.244 \times 100 = 2.5\%$, respectively.

The positive cross-price effects between Costa Rica and the other exporting countries, particularly Guatemala also explains the decline in Costa Rica's share of the U.S. market. While there has been little difference in banana prices across the supplying countries on average, throughout most of the data period Costa Rica's price relative to Guatemala has been consistently greater than one and has trended upward from about 1.0 in 2006 to greater than 1.4 in 2009, a few outliers aside (Figure 1). It is during this period when Costa Rica experienced the greatest decline in market share: from 24.7% in 2006 to 14.5% in 2009. During this same period, Guatemala's share increased from 21.6% to 29.6%.

[Place Figure 1 approximately here]

The short- and long-run expenditure elasticity, and Hicksian and Marshallian own-price elasticities are reported in Table 6. The expenditure elasticities indicate that imports from Costa Rica (1.266), Guatemala (1.151), and Honduras (1.142) are highly responsive to expenditures in the short-run where as imports from Colombia (0.714), Ecuador (0.743), and ROW (0.495) are expenditure-inelastic in the short-run. With the exception of bananas from Ecuador, U.S. banana imports are expenditure-elastic in the long-run. Recall that the two-month own-lag effect was positive and significant for Guatemala. Consequently, the long-run expenditure elasticity for Guatemala (2.238) is particularly large when compare to the other exporting countries. The long-run expenditure elasticities for the remaining countries (in order of value) are 1.865 (Costa Rica), 1.522 (Colombia), 1.375 Honduras, 1.144 (ROW), and 0.927 (Ecuador).

The uncompensated own-price elasticities show that U.S. banana demand by country is mostly inelastic in the short- and long-run. The exceptions are Costa Rica and ROW where the long-run responsiveness of imports to a percentage change in price is -1.252% and -1.917%, respectively. U.S. imports from Ecuador is highly inelastic in both the short- and long-run

(-0.308 and -0.401, respectively), and while imports from Guatemala are also highly inelastic in the short-run (-0.366), they are more responsive in long-run (-0.712). Lastly, imports from Honduras are relative more elastic when compared to Ecuador and Guatemala in both the short-run (-0.783) and long-run (-0.942).

[Place Table 6 approximately here]

The short- and long-run Hicksian cross-price elasticities are reported in Table 7.[3] These estimates further show the competitive relationship between Costa Rica and the following: Ecuador, Guatemala, Honduras and ROW. In the long-run, the responsiveness of imports from Costa Rica to a percentage increase in price is 0.323, 0.405, 0.327 and 0.129 for Ecuador, Guatemala, Honduras and ROW, respectively. The long-run effect of Costa Rica's price on Guatemala, Honduras and ROW is relatively larger particularly for the ROW where the responsiveness is 1.381.

[Place Table 7 approximately here]

6. Summary and Conclusion

U.S. banana demand differentiated by country of origin was estimated using the generalized dynamic Rotterdam model. Results indicate that dynamic factors play a significant role in determining the allocation of U.S. banana expenditures across exporting sources. Of particular interest was Guatemala's increased share and Costa Rica's decreased share of the U.S. banana market. A number of factors explained why Guatemala replaced Costa Rica as the leading U.S. supplier in 2007. (1) Guatemala is the least expensive exporting source on average. (2) Habit persistence, adjustment costs, and other dynamic factors favor Guatemala's exports. (3) Given

[3] Marshallian cross-price elasticities were mostly insignificant and are not reported.

increases in the relative price of Costa Rica's bananas, the price competition between Costa Rica and Guatemala is highly significant. (4) Bananas from Costa Rica are highly responsive to own-price while imports from Guatemala are more price-inelastic. (5) Heavy rains and fluctuating temperatures in Costa Rica have decreased banana production and exports.

Costa Rica's decline as a U.S. supplier reflects the fact that the United States has become relatively less important as a destination market for Costa Rican bananas. For instance, in 2001 total banana exports for Costa Rica were $509 million and the United States was the most important market accounting for 58%. Overtime, the EU has become increasingly important to Cost Rica. In 2009, Costa Rica's banana exports increased to $712 million but the United States accounted for a smaller percent of total exports (46%) while the EU accounted for 51% (UN Comtrade, 2010).

National policies of the banana-producing countries likely affect the relative competitiveness of the banana exporting countries in terms of price, quality of product, and variability of supply. For instance, both Costa Rica and Ecuador administer minimum reference prices for their banana exports; these reference prices are intended to assure a minimum return when their product is marketed abroad. In Ecuador, these reference prices were recently buttressed by a round of inspections in response to complaints that some exporters were paying less than half the official price (El Universo, 2010).

Although this study focused on U.S. banana demand, supply factors in the exporting countries could also explain Costa Rica's decline. Given the risk associated with importing, the United States does not rely on a single source for total banana supply and it is likely that volatile production in one country could significantly impact U.S. demand. Consequently, as one country becomes a less reliable source, importers reallocate resources to other exporting

countries. Banana production in Costa Rica has been quite erratic since 2001 increasing by as much as 21% in 2006 and decreasing by as much as 20% in 2008 (FAOSTAT, 2010). In contrast, banana production in Guatemala has been steadily increasing since 2003. Production in 2009 was particularly in Costa Rica where heavy rains and fluctuating temperatures negatively impacted supply. As a result, exports were down by 40% which may explain why Costa Rica's share of the U.S. market decreased to 14.5% in 2009 (UN Comtrade, 2010).

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Table 1. U.S. Banana Imports and Exporter Market Shares

Year	Value ($ millions)	Change (%)	Market Share (%)					
			Colombia	Costa Rica	Ecuador	Guatemala	Honduras	ROW
2000	1,026.39		17.18	31.39	23.05	17.57	7.37	3.43
2001	1,069.35	4.19	13.37	28.75	22.98	21.13	10.26	3.51
2002	1,064.30	-0.47	14.03	23.09	25.50	23.19	11.25	2.95
2003	1,038.15	-2.46	12.34	25.86	24.62	23.67	10.74	2.78
2004	1,008.00	-2.90	12.18	23.42	22.92	25.77	12.74	2.96
2005	1,036.84	2.86	14.08	22.21	23.01	26.00	11.53	3.17
2006	1,101.18	6.21	13.01	24.71	26.25	21.60	10.57	3.85
2007	1,126.74	2.32	10.44	25.35	22.96	26.35	12.14	2.77
2008	1,254.89	11.37	12.97	20.25	21.49	28.56	12.20	4.54
2009	1,454.68	15.92	13.37	14.46	26.44	29.60	11.09	5.05

Source: Foreign Agricultural Service, USDA

Table 2. Descriptive Statistics for U.S. Banana Imports: January 2000-March 2010

	Price ($US/kg)		Quantity (kg)		Value ($US)		Import Share (%)	
Country	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Colombia	0.319	0.069	39,529,100	6,662,105	12,493,200	2,747,052	13.29	2.15
Costa Rica	0.292	0.062	77,960,300	20,639,700	22,008,400	4,305,919	23.80	5.17
Ecuador	0.288	0.064	78,952,600	13,939,000	22,562,600	5,418,918	23.96	4.10
Guatemala	0.284	0.060	81,595,600	17,723,600	23,221,700	7,098,690	24.39	4.67
Honduras	0.294	0.067	35,871,100	8,235,002	10,382,600	2,743,382	11.01	2.22
ROW	0.354	0.068	9,537,564	2,927,141	3,431,336	1,472,596	3.55	1.02

Note: ROW is the rest of the world.

Table 3. Likelihood Ratio Tests Results

Models	Log-likelihood Value	LR Statistic	Restricted parameters	P-value
Unrestricted Model	1,451.430			
Homogeneity	1,448.077	6.706	5	0.243
Homogeneity and Symmetry	1,446.713	2.729	10	0.987
Dynamic Models				
Three-month lags	1,466.229			
Two-month lags	1,446.713	39.033	30	0.125
One-month lags	1,411.996	69.433	30	0.000
No lags with constant	1,310.740	202.511	30	0.000
No constants	1294.772	31.9373	5	0.000

All models have homogeneity and symmetry imposed.
[a] The number of restrictions is in parenthesis.

Table 4. Partial Adjustment Estimates for U.S. Banana Imports

	One-month lag γ_{ij1}						Two-month lag γ_{ij2}					
Country	Colombia	Costa Rica	Ecuador	Guatemala	Honduras	ROW	Colombia	Costa Rica	Ecuador	Guatemala	Honduras	ROW
Colombia	0.0585[a]	-0.0027	-0.0182[c]	-0.0501[a]	-0.0127	0.0127[b]	0.0106	-0.0249[a]	0.0025	0.0184	0.0116[c]	-0.0116[c]
	(0.011)	(0.007)	(0.010)	(0.012)	(0.008)	(0.006)	(0.011)	(0.007)	(0.010)	(0.013)	(0.007)	(0.006)
Costa Rica	-0.1092[a]	0.0532[a]	-0.0208	0.0101	-0.0016	-0.0169	0.0308	0.0231	0.0335	-0.0600[b]	0.0040	0.0467[a]
	(0.026)	(0.016)	(0.023)	(0.028)	(0.018)	(0.014)	(0.024)	(0.015)	(0.022)	(0.030)	(0.016)	(0.014)
Ecuador	-0.0011	-0.0303[b]	0.0499[b]	-0.0312	-0.0067	0.0021	0.0113	0.0109	0.0056	-0.0350	-0.0185	-0.0230[c]
	(0.024)	(0.015)	(0.021)	(0.026)	(0.017)	(0.013)	(0.023)	(0.014)	(0.020)	(0.028)	(0.015)	(0.013)
Guatemala	0.0466[a]	-0.0121	0.0077	0.0522[a]	-0.0110	0.0012	-0.0391[b]	-0.0042	-0.0152	0.0672[a]	0.0108	-0.0159[c]
	(0.017)	(0.011)	(0.015)	(0.019)	(0.012)	(0.010)	(0.016)	(0.010)	(0.014)	(0.020)	(0.011)	(0.009)
Honduras	-0.0030	-0.0099	-0.0197[c]	0.0279[b]	0.0365[a]	-0.0146[b]	-0.0200[c]	-0.0023	-0.0190[c]	0.0136	-0.0174[b]	-0.0003
	(0.012)	(0.007)	(0.010)	(0.013)	(0.008)	(0.007)	(0.011)	(0.007)	(0.010)	(0.014)	(0.007)	(0.006)
ROW	0.0082	0.0018	0.0011	-0.0090	-0.0045	0.0155[a]	0.0063	-0.0027	-0.0074	-0.0042	0.0095[b]	0.0041
	(0.006)	(0.004)	(0.006)	(0.007)	(0.005)	(0.004)	(0.006)	(0.004)	(0.005)	(0.008)	(0.004)	(0.004)

Note: Asymptotic standard errors are in parentheses. a, b and c denote the 0.01, 0.05 and 0.10 significance level, respectively. ROW is the rest of the world.

Table 5. Conditional Demand Estimates for U.S. Banana Imports

Country	Constant γ_i	Expenditure θ_i	Slutsky Price Effects π_{ij}					
			Colombia	Costa Rica	Ecuador	Guatemala	Honduras	ROW
Colombia	-0.0024	0.0929[a]	-0.0017	-0.0604[a]	0.0295[b]	0.0049	0.0230[c]	0.0047
	(0.002)	(0.017)	(0.016)	(0.018)	(0.015)	(0.017)	(0.012)	(0.008)
Costa Rica	-0.0083[c]	0.3006[a]		-0.1304[a]	0.0521[c]	0.0653[b]	0.0527[a]	0.0207[c]
	(0.004)	(0.036)		(0.048)	(0.030)	(0.031)	(0.019)	(0.012)
Ecuador	0.0034	0.1776[a]			-0.0311	-0.0502[b]	-0.0043	0.0041
	(0.004)	(0.033)			(0.033)	(0.022)	(0.015)	(0.009)
Guatemala	0.0061[b]	0.2832[a]				-0.0204	0.0020	-0.0016
	(0.003)	(0.025)				(0.036)	(0.020)	(0.012)
Honduras	-0.0013	0.1286[a]					-0.0737[a]	0.0003
	(0.002)	(0.017)					(0.018)	(0.009)
ROW	0.0024[b]	0.0172[c]						-0.0282[a]
	(0.001)	(0.010)						(0.008)
		Equation R^2	0.66	0.66	0.39	0.71	0.69	0.47

Note: homogeneity and symmetry are imposed. Asymptotic standard errors are in parentheses.
a, b and c denote the 0.01, 0.05 and 0.10 significance level, respectively.
ROW is the rest of the world.

Table 6. Short- and Long-run Demand Elasticities

	Short-run	Long-run
	Expenditure	
Colombia	0.714 (0.127)[a]	1.522 (0.391)[a]
Costa Rica	1.266 (0.153)[a]	1.865 (0.284)[a]
Ecuador	0.743 (0.138)[a]	0.967 (0.222)[a]
Guatemala	1.151 (0.100)[a]	2.238 (0.395)[a]
Honduras	1.142 (0.150)[a]	1.375 (0.219)[a]
ROW	0.495 (0.283)[c]	1.144 (0.703)
	Hicksian own-price	
Colombia	-0.013 (0.122)	-0.028 (0.262)
Costa Rica	-0.549 (0.201)[a]	-0.809 (0.280)[a]
Ecuador	-0.130 (0.139)	-0.170 (0.182)
Guatemala	-0.083 (0.145)	-0.161 (0.290)
Honduras	-0.654 (0.159)[a]	-0.787 (0.192)[a]
ROW	-0.813 (0.238)[a]	-1.877 (0.708)[a]
	Marshallian own-price	
Colombia	-0.106 (0.129)	-0.226 (0.283)
Costa Rica	-0.850 (0.193)[a]	-1.252 (0.267)[a]
Ecuador	-0.308 (0.146)[b]	-0.401 (0.198)[b]
Guatemala	-0.366 (0.149)[b]	-0.712 (0.337)[b]
Honduras	-0.783 (0.157)[a]	-0.942 (0.192)[a]
ROW	-0.830 (0.238)[a]	-1.917 (0.720)[a]

Note: Asymptotic standard errors are in parentheses. a, b and c denote the 0.01, 0.05 and 0.10 significance level, respectively. ROW is the rest of the world.

Table 7. Hicksian Cross-Price Elasticities

Quantity/Price	Colombia	Costa Rica	Ecuador	Guatemala	Honduras	ROW
			Short-run			
Colombia		-0.464 (0.140)[a]	0.227 (0.115)[b]	0.038 (0.132)	0.177 (0.095)[c]	0.036 (0.061)
Costa Rica	-0.254 (0.077)[a]		0.219 (0.128)[c]	0.275 (0.129)[b]	0.222 (0.081)[a]	0.087 (0.049)[c]
Ecuador	0.123 (0.062)[b]	0.218 (0.127)[c]		-0.210 (0.090)[b]	-0.018 (0.062)	0.017 (0.039)
Guatemala	0.020 (0.070)	0.265 (0.124)[b]	-0.204 (0.087)[b]		0.008 (0.080)	-0.007 (0.048)
Honduras	0.204 (0.110)[c]	0.468 (0.171)[a]	-0.039 (0.132)	0.018 (0.175)		0.003 (0.076)
ROW	0.135 (0.228)	0.597 (0.336)[c]	0.118 (0.268)	-0.046 (0.343)	0.008 (0.246)	
			Long-run			
Colombia		-0.990 (0.280)[a]	0.483 (0.242)[b]	0.081 (0.281)	0.377 (0.220)[c]	0.077 (0.128)
Costa Rica	-0.375 (0.121)[a]		0.323 (0.184)[c]	0.405 (0.187)[b]	0.327 (0.122)[a]	0.129 (0.072)[c]
Ecuador	0.161 (0.084)[c]	0.284 (0.168)[c]		-0.273 (0.120)[b]	-0.024 (0.081)	0.022 (0.051)
Guatemala	0.039 (0.136)	0.516 (0.264)[b]	-0.397 (0.171)[b]		0.016 (0.156)	-0.013 (0.094)
Honduras	0.246 (0.131)[c]	0.563 (0.207)[a]	-0.046 (0.159)	0.022 (0.211)		0.003 (0.091)
ROW	0.313 (0.526)	1.381 (0.748)[c]	0.272 (0.635)	-0.107 (0.787)	0.019 (0.567)	

Note: Asymptotic standard errors are in parentheses. a, b and c denote the 0.01, 0.05 and 0.10 significance level, respectively. ROW is the rest of the world.

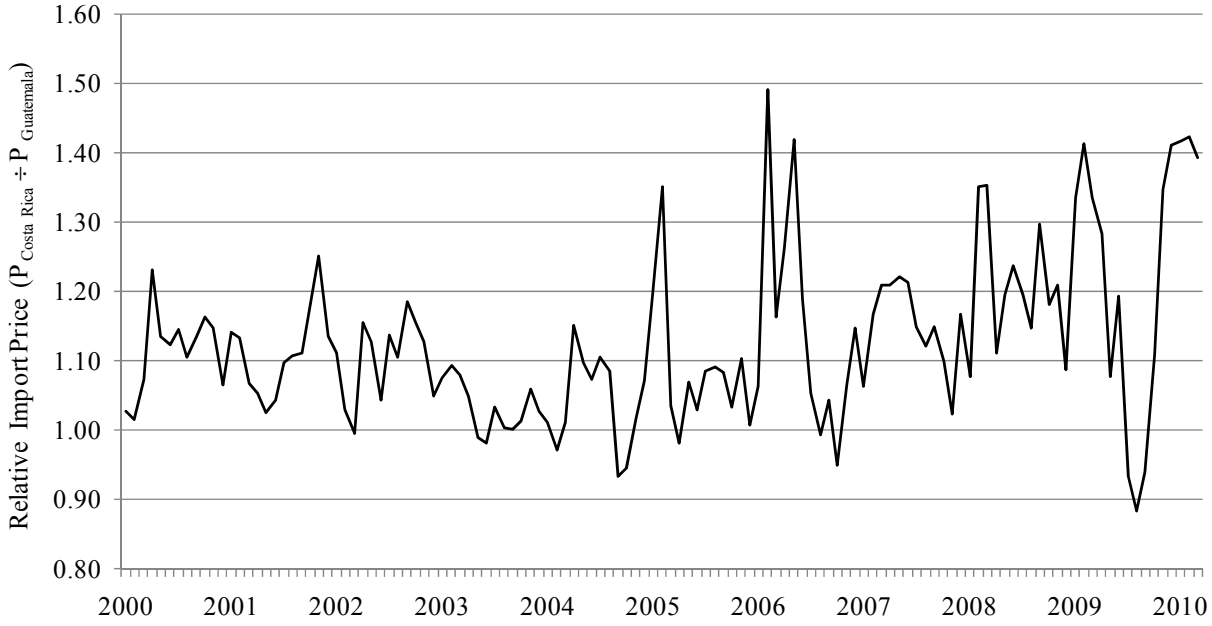

Figure 1. Relative Price of Banana Imports from Costa Rica