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European Union Import Demand for In-Shell Peanuts

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This paper analyzes the European Union (EU) import demand for in-shell peanuts from three sources: the United States, China, and the rest of the world. We find that peanuts from different sources are differentiated by EU consumers. The expenditure elasticity is elastic for U.S. in-shell peanuts, which is associated with their higher quality. The conditional own price elasticities are more elastic for U.S. and Chinese in-shell peanuts. These findings have at least two implications. First, U.S. producers and exporters should direct efforts to ensure that in-shell peanuts exported to the EU are of the best possible quality, and, second, promotion efforts should stress the quality of U.S peanuts as an advertising tool.

Key Words: European Union import demand, in-shell peanuts, nonlinear SAIDS

JEL Classifications: D12, Q11, Q17

The European Union (EU[1]) is the largest importer of peanuts in the world. In 2005, its peanut imports accounted for around 40% of the world imports of this commodity (FAOSTAT). However, little economic research has been done on the EU markets for peanuts. To the best of our knowledge, this is the first paper analyzing the EU import demand for peanuts.

A few studies have been conducted on the topic of the demand for U.S. peanuts in foreign markets. For example, Zhang, Fletcher, and Carley estimated Japan's import demand for peanuts to determine the impact of an increase in the Japanese raw peanut quota on peanut imports from the United States and its competitors. In the past, economic studies of peanut markets have focused on the analysis of government intervention in the U.S. domestic and/or international peanut market (e.g., Borges; Borges and Thurman; Miller and Mabbs-Zero). These topics have become less important due to the fact that the free-trade agreements signed by the United States have forced a cut in trade, distorting domestic support to the agricultural sector. Furthermore, the Untied States changed the peanut program in 2002 from a domestic supply management with government intervention to a competition market program. Therefore, a new focus of economic

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[1] This study only focuses on EU-15 countries because the data for all EU-27 are not available prior to 1995. Moreover, the EU-15 countries account for 99% of the total import quantities for in-shell peanuts in the European Union (EUROSTAT). The countries included in the EU-15 are Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Sweden. Currently the EU has 27 country members.

analysis on the U.S. competitive stand in the global peanut market is warranted.

The EU imports peanuts mainly from China, the United States, Latin America, and Africa. EU countries import two types of peanuts: 1) in-shell peanuts and 2) shelled peanuts. Both types are completely different because in-shell peanuts are consumed directly by consumers but shelled peanuts are imported by processors to produce peanut butter, candy, snacks, etc.

The principal objective of this study is to analyze the EU import demand for in-shell peanuts, with a special emphasis on the EU demand for U.S. in-shell peanuts. Specific objectives include the estimation of price and expenditure elasticities and testing product aggregation to see whether U.S. in-shell peanuts are differentiated from other countries. The results are used to analyze the competitiveness of U.S. in-shell peanuts in the EU market and suggest some implications of our findings for marketing this type of U.S. peanut in the EU.

The study of EU markets for in-shell peanuts is useful for U.S. in-shell peanut exporters because in the last decade, the U.S. share of the total import quantity of in-shell peanuts in the EU has declined, whereas China, Africa, and Latin America have increased their export shares. The results from this study can be utilized to better understand the changes in the demand for in-shell peanuts in the world market and to provide useful information for policy makers in government and peanut industry organizations assisting the U.S. peanut producers and processors to compete in a highly competitive market environment. For example, policy makers and researchers could use these results to analyze and quantify the potential impact of federal promotion programs on the EU demand for U.S. in-shell peanuts.

Background Information on World Peanut Trade

According to the Production, Supply, and Distribution (PSD online) database of the Foreign Agricultural Service of the U.S. Department of Agriculture (USDA), the main suppliers of peanuts to the world peanut market are Argentina, China, and the United States, which account for 70% of total export quantity. In 2005, the total quantity of world peanut exports was 2,005 million kg. Out of this total amount, Argentina exported 400 million kg, China exported 784 million kg, and the United States exported 223 million kg. Out of the total U.S. peanut exports, the U.S. export quantities of in-shell peanuts make up only 7.35%, but it is very important for some U.S. states, such as Virginia, North Carolina, South Carolina, Texas, and New Mexico, which are the main source of in-shell production.

The main importers of peanuts in the world are Canada, the EU, Japan, and Mexico. These four importers account for more than 60% of total imports. In 2005, Canada, Japan, and Mexico each accounted for about 7% of the total world import quantities, and the EU accounted for around 38–39%. Hence, the EU is the largest importer of peanuts by quantity and value. The total quantity of peanuts imported by the EU was 778 million kg. Out of this total amount, the EU total quantity import of in-shell peanuts was around 109.57 million kg or 14% of their total import quantities of peanuts.

China, the United States, Latin America, and Africa are the major exporters of in-shell peanuts to the EU. They accounted for more than 96% of the total value and quantity of EU in-shell peanut imports between 1991 and 2005 (EUROSTAT). Whereas the demand for in-shell peanuts in Europe has been steady, the competition among exporters has changed. China is now the dominant exporter of in-shell peanuts. Both African and Latin American countries have increased their export share, while the U.S. export share for in-shell peanuts has decreased over time.

In the early 1990s, the United States and China were the main exporters of in-shell peanuts to the EU. For example, in 1991, the United States and China exported to the EU 35.62 and 40.90 million kg of in-shell peanuts, respectively. The U.S. exports of in-shell peanuts peaked in 1995, when it reached a level of exports of 70.53 million kg, followed by China (29.75 million kg), Latin America (2.54 million kg), and Africa (2.52 million kg). In 1996, China became the dominant exporter of in-shell peanuts to the EU markets, exporting 36.51 million kg, followed by the United States (21.77 million kg), Africa (2.73 million kg), and Latin America (1.96 million kg). The U.S. exports of in-shell peanuts have been declining over time. In 2005, the United States only exported around 10.90 million kg of in-shell peanuts to the EU.

Source-Differentiated AIDS Model

A Source-Differentiated AIDS (Almost Ideal Demand System) Model (SAIDS) was first specified by Yang and Koo. The SAIDS model allows for source differentiation, and it closely follows the derivation of the AIDS model proposed by Deaton and Muellbauer. This model has been previously used for import demand for meat (Henneberry and Hwang; Yang and Koo), import demand for fresh fruits (Andayani and Tilley; Schmitz and Seale), and import demand for wine (Carew, Florkowski, and He). The SAIDS model also allows the user to disaggregate and differentiate products by origin.

The SAIDS model is derived from a price-independent generalized logarithmic expenditure function that accounts for the importer's behavior and differentiates goods from different origins. Even though tariffs and quotas on imported peanuts and peanut products have become negligible in the EU, there are several reasons why EU consumers may still differentiate peanuts from different origins. One of these reasons is food safety concerns, especially aflatoxin level. Since peanuts from different sources have different quality attributes (Bliss), it is important to recognize quality differences among peanut exporters when analyzing the EU peanut import demand.

Applying Shephard's lemma to the expenditure function, the source-differentiated AIDS model for one product (in-shell peanuts from different origins in this case) can be written as

$$w_i = \alpha_i + \sum_{j \in g} \gamma_{ij} \ln p_j + \beta_i \ln\left(x_g / P_g\right) + u_i, \quad (1)$$

where $\ln P_g = \alpha_0 + \Sigma_{k \in g} \alpha_k \ln p_k + 1/2(\Sigma_{k \in g} \Sigma_{l \in g} \gamma_{kl} \ln p_k \ln p_l)$ is a price index, g represents the group, x_g $(= \Sigma_{i \in g} p_i q_i)$ is total expenditure on in-shell peanuts from countries $i \in g$ (= China, United States, or rest of the world [ROW]), p_i and q_i are the price and quantity of in-shell peanuts from country i, $w_i = p_i q_i / x_g$ is the conditional budget share of in-shell peanuts from all the imported sources, and u_i is the residual term of in-shell peanuts from country i.

Previous studies using the SAIDS have used the Stone price index as a proxy for the price index derived analytically from the AIDS cost function; however, several studies on consumer demand have shown that the Linear Almost Ideal Demand System could produce biased estimates of demand elasticities (Buse; Chen; Moschini). Therefore, the SAIDS model should be estimated as a nonlinear model (NLSAIDS) instead of using its linear approximation, because policy evaluations and simulations require reliable estimates of demand responsiveness to prices and expenditure.

Consistent with demand theory, the demand restrictions are the sum of ($\Sigma_{i=1}^{g} \alpha_i = 1$, $\Sigma_{i=1}^{g} \gamma_{ij} = 0$, $\Sigma_{i=1}^{g} \beta_i = 0$), homogeneity ($\Sigma_{j \in g} \gamma_{ij} = 0$), and symmetry ($\gamma_{ij} = \gamma_{ji}$, for all $i, j \in g$).

To test the hypothesis of product aggregation, the AIDS model that does not differentiate the product by origins can be estimated. Estimation of the AIDS model corresponds to the following restrictions on the SAIDS model (Hayes, Wahl, and Williams):

$$\alpha_i = \alpha_g, \quad \forall i \in g,$$
$$\gamma_{ij} = \gamma_g, \quad \forall i, j \in g,$$
$$\beta_i = \beta_g, \quad \forall i \in g.$$

These restrictions imply that the price and expenditure coefficients from the different sources are equal.

The estimated parameters from Equation (1) are utilized to compute income, own-price, and cross-price elasticities. The formulas of income elasticities, Marshallian price elasticities, and Hicksian price elasticities for the nonlinear SAIDS model are presented as Equations (2), (3), and (4), respectively.

$$(2) \quad \eta_i = 1 + (\beta_i / w_i),$$

$$(3) \quad \varepsilon_{ij} = -\delta_{ij} + \left(\gamma_{ij} - \beta_i \ln\left(x_g / P_g\right)\right) \Big/ w_i,$$

$$(4) \quad \varepsilon^*_{ij} = \varepsilon_{ij} + w_j \eta_i,$$

where $\delta_{ij} = 1$ if $i = j$, and $\delta_{ij} = 0$ if $i \neq j$.

To identify whether the goods are substitutes or complements, the Morishima elasticities were calculated using the following equation (Blackorby and Russell):

$$(5) \quad M_{ij} = \varepsilon^*_{ij} - \varepsilon^*_{ii}.$$

These elasticities measure the percentage change in the consumption ratio $h_i(p, u)/h_j(p, u)$ due to a 1% change in the corresponding ratio p_i/p_j. Morishima elasticities of substitution are a very natural measure of substitutability, because by focusing on price and quantity ratios, they reflect the curvature of indifference curves. If the Morishima elasticities are positive, the goods are considered to be substitutes. If the Morishima elasticities are negative, the goods are considered to be complements.

Data and Procedures

The data used to estimate the model are quarterly data from 1991 to 2005, representing a total of 60 observations. The sources of origin of the EU imports of in-shell peanuts considered in this study are China, the United States, and rest of the world (ROW)[2]. The data were obtained from the EUROSTAT database. The quantity of imports from each source is measured in 100,000 kg, and the value of imports is measured in 1,000 Euros. Since import price data are not available, unit prices[3] are used as import prices.

The EU countries grow a trivial amount of peanuts because the climate condition in Europe is not suitable for growing peanuts. Their peanut production is infinitesimal relative to the amount of their peanut imports[4]; therefore, domestic production can be ignored.

Diagnostic Tests

Model misspecification may lead to biased and inconsistent estimators and/or inappropriate statistical inferences. Therefore, it is important to perform diagnostic tests on the models. In the context of demand systems of equations, practitioners usually perform misspecification tests separately for each of the equations in the system and then combine the results in an ad hoc manner. A more appropriate approach is to conduct the misspecification tests for the system as a whole (McGuirk et al.; Shukur).

Following Shukur, the Breusch-Godfrey (BG) systemwise test was used to test for autocorrelation, the Breusch-Pagan (BP) test was used to test for heteroskedasticity, and the systemwise RESET test was utilized for functional misspecification. All the tests were performed using a multivariate F-test (Shukur, p. 710).

To test for the presence of expenditure endogeneity, we utilized the approach suggested by Blundell and Robin (p. 76). In this approach, each share equation is augmented with the error v from a reduced form for the log expenditure ($\ln x_g$). The error u_i in

[2] The reason for aggregating Latin America and Africa with the rest of the world was empirical. Initially, we modeled the EU import demand for in-shell peanuts from five different sources: China, U.S., Latin American, Africa, and rest of the world. The parameters of the EU import demand for Latin American and African in-shell peanuts were mostly not statistically significant.

The average conditional budget share of in-shell peanuts from China and the United States was 0.53 and 0.33, respectively. Therefore, these two countries together account for more than 85% of EU import demand for in-shell peanuts.

[3] Unit prices of imported in-shell peanut from each country were computed by dividing total value by total quantity of imports.

[4] The EU production is less than 0.0001% of total world production and is less than 0.01% of total EU import of peanuts. The data for EU and world peanut production are available at Production, Supply, and Distribution (PSD online) from the FAS, USDA.

Equation (1) is written as the orthogonal decomposition $u_i = \omega_i v + \xi_i$, where $E(\xi_i \mid \ln x_g, \ln p_1, \ldots, \ln p_g) = 0$. Similar to Blundell and Robin, we define the reduced form equation for log expenditure ($\ln x_g$) as a function of a linear trend, seasonal dummies, and prices of in-shell peanuts. The hypothesis that the parameters ω_i are significantly different from zero can be used to test the exogeneity of log expenditures.

Standard Errors in the Nonlinear AIDS Model

Estimation of the standard errors for the elasticities in the nonlinear AIDS (and the nonlinear SAIDS) is complicated by the fact that these elasticities are nonlinear functions of several parameter estimates. For example, the cross price elasticity ε_{ij} (Equation [3]) is a function of γ_{ij}, β_i, and also of all the parameters that enter into the price index P_g. The bootstrap method was utilized to calculate the standard error of elasticities in this study, specifically, a modified version of the moving blocks bootstrap (MBB) method for time series (Goncalves and White). Previous studies using the bootstrap method to estimate standard errors of elasticities (Green, Hahn, and Rocke; Li and Maddala) have assumed specific data-generating processes. Green, Hahn and Rocke assumed a first-order autocorrelation process, whereas Li and Maddala assumed an autoregressive distributed lag model. In contrast, the MBB does not assume any specific dynamic data-generating process (Hardle, Horowitz, and Kreiss).

The MBB used in this study is as follows. Let θ° be the parameter vector with elements α_i, γ_{ij}, and β_i, for all $i = 1, 2, \ldots, g$, and for all $j = 1, 2, \ldots, g$ (Equation [1]). Then, $\hat{\theta}^*$ is the Nonlinear Least Squares (NLS) or Seemingly Unrelated Regression (SUR) estimator of θ° based on the bootstrap data $\mathbf{Z}^*_{nt} = \left(\mathbf{Y}^*_{nt}, \mathbf{X}^*_{nt}\right)$, where $\mathbf{Y}^*_{nt}$ represents the vector of dependent variables, and $\mathbf{X}^*_{nt}$ represents the matrix of explanatory variables included in Equation (1) (Greene). Let $\ell = \ell_n \in \mathrm{N}(1 \leq \ell \leq n)$ denote the length of the blocks, and let $\mathbf{B}_{t,\ell} = \{\mathbf{Z}_t, \mathbf{Z}_{t+1}, \ldots, \mathbf{Z}_{t+\ell-1}\}$ be the block of ℓ consecutive observations starting at $\mathbf{Z}_t$. The MBB resample $k = n/\ell$ blocks randomly with replacement from the set of $n - \ell + 1$ overlapping blocks $\{\mathbf{B}_{t,\ell}, \ldots, \mathbf{B}_{t-\ell+1,\ell}\}$ (Goncalves and White). The modification of the procedure outlined by Goncalves and White involved the use of NLS or SUR instead of linear squares and the use of the estimator in the context of a system of equations framework rather than in a single equation.

The bootstrap variance covariance estimator of $\hat{\theta}^*$, the NLS or SUR estimator of θ°, is given by an approximation to the bootstrap population variance covariance matrix of $\mathrm{var}^*(\sqrt{n}\,[\hat{\theta}^* - \theta^\circ])$, which can be computed as $n/B\ \Sigma_1^B\left(\hat{\theta}^{*(i)} - \hat{\bar{\theta}}^*\right)\hat{\theta}^{*(i)} - \hat{\bar{\theta}}^*\Big)$, where $\hat{\bar{\theta}}^* = \frac{1}{B}\Sigma_1^B\left(\hat{\theta}^{*(i)}\right)$ and $\hat{\theta}^{*(i)}$ is the bootstrap NLS or SUR estimator evaluated on the ith bootstrap replication, and B is the total number of bootstrap replications. For this study, $B = 999$ replications. Also, given that autocorrelation tests provided evidence of first-order autocorrelation, blocks of two or more observations (i.e., $\ell \geq 2$) were utilized.

Empirical Estimation

The estimated system of equations is conditional on the EU total expenditure on imported in-shell peanuts. To make the estimation manageable, we assume that the EU consumers allocate their total expenditure among groups of goods, in-shell peanuts being one of them. We also assume that preferences among these groups are weakly separable. For the allocation of expenditure for the in-shell peanut group, the EU consumers select imported in-shell peanuts from three different sources (China, the United States, and ROW).

The conditional demand system contains three equations representing EU import demand equations for Chinese, the United States, and ROW in-shell peanuts. The additional explanatory variables included in the conditional demand system are time trend and seasonal dummy variables. The time trend is included to model any systematic effect that is not captured by income, price, or seasonal dummy variables (Burton and Young; Piggott

Table 1. Test Results for Demand Restrictions and Product Aggregation

	Nonlinear SAIDS	
	Likelihood Ratio statistic	$\Pr > \chi^2$
System tests for homogeneity	4.38	0.1117
System tests for symmetry	0.25	0.6170
System tests for homogeneity and symmetry	4.66	0.1982
Product aggregation	Wald *F* value 35.88	<.0001

et al.). The ROW equation for in-shell peanuts was dropped to avoid singularity problems since the expenditure shares in the conditional demand system sum to one. The parameters of both the unrestricted and restricted conditional demand system are estimated by the seemingly unrelated regression (SUR) method.

Tests of homogeneity and symmetry were conducted on the unrestricted demand system, taking into account that cross price effects are source-differentiated within a product. The test of product aggregation was performed on the restricted demand system (Carew, Florkowski, and He). The MODEL procedure from SAS was used for estimation. The Lagrange multiplier test was utilized to test for serially correlated residuals in each equation.

Results

The null hypothesis of no autocorrelation in the Breusch-Godfrey test was rejected, indicating that the data are serially correlated. The system of demand equations was estimated and corrected for first-order autocorrelation. Since the model is a singular equation system, we follow the first-order autocorrelation correction procedure proposed by Berndt and Savin. This approach assumes a constant autocorrelation coefficient in all the equations of the system of equations and zero cross equation autocorrelation. The estimated value of the first autocorrelation coefficient is 0.399, which was significant at the 5% statistical level.

After correcting for the autocorrelation problem, the systemwise RESET test for functional misspecification (p value = 0.925), the Breusch-Pagan systemwise test for heteroskedasticity (p value = 0.745), and the Breusch-Godfrey systemwise test for autocorrelation (p value = 0.244) failed to reject the null hypothesis that there was no misspecification problem. The exogeneity test also failed to reject the null hypothesis that log expenditures were exogenous.

The results of the tests of the homogeneity and symmetry restrictions in the SAIDS model after correction for the first autocorrelation are presented in Table 1. The likelihood ratio tests failed to reject the null hypothesis that symmetry or homogeneity, or symmetry and homogeneity restrictions are satisfied.

The result of the test of product aggregation is shown in Table 1. A Wald F–test was used for this purpose. The null hypothesis of product aggregation, which maintains that in-shell peanuts from different production sources are perfect substitutes, is rejected. These results suggest that in-shell peanuts from different sources are differentiated by EU consumers, which can be attributed to their different quality characteristics. In fact, in-shell peanuts are not a homogeneous commodity. They are distinguished by quality characteristics such as freshness and flavor (American Peanut Council).

Parameter Estimates

Estimation results of the nonlinear SAIDS model after the correction of the first-order autocorrelation are shown in Table 2. The time trend variable has a statistically significant negative effect for import demand for U.S. in-shell peanuts, which reflects U.S. export of in-shell peanuts decreasing over time. However, this variable has a positive

Table 2. Parameter Estimates for the Restricted Conditional Nonlinear SAIDS Model of EU Import Demand for In-Shell Peanuts (Homogeneity and Symmetry Imposed)

	China	U.S.	Rest of the World (ROW)
Price effects (γ_{ij})			
China	−0.4063** (0.1139)		
U.S.	0.4052** (0.1582)	−0.5445** (0.2620)	
ROW	0.0011 (0.1390)	0.1394 (0.1799)	−0.1405 (0.1918)
Expenditure effects	−0.0182 (0.0711)	0.1361** (0.0665)	−0.0276 (0.0591)
Time trend	0.0007 (0.0009)	−0.0049** (0.0008)	0.0003 (0.0006)
Seasonal effects			
Quarter 1 (January–March)	0.1074** (0.0448)	−0.0669 (0.0420)	−0.0105 (0.0349)
Quarter 2 (April–June)	0.1365** (0.0438)	−0.0873** (0.0405)	−0.0073 (0.0333)
Quarter 3 (July–September)	0.2218** (0.0472)	−0.1366** (0.0435)	−0.0084 (0.0358)
R^2	0.6256	0.7517	0.1801
Adjusted R^2	0.5743	0.7176	0.0676
DW	2.1149	1.8327	1.8949

Note: The values in parentheses are the standard errors. Superscripts ** denote statistical significance at 5% levels.

effect but it is insignificant for EU imports from China and the rest of the world.

Dummy variables measuring the effects of seasonality show that import demand for U.S. in-shell peanuts is high during the October–December season, which coincides with the harvesting season of peanuts in the United States from September to November and also with the higher consumption demand of the product during the Christmas and New Year holiday season. The imported share of U.S. in-shell peanuts declines around 6.7–8.7% in the first and second quarter and rises almost 13.7% in the third quarter. The seasonal dummy variables also show that import demand for Chinese in-shell peanuts does not coincide with the Chinese harvesting season from October to December. This indicates that in China in-shell peanuts are stored and sold during off season. Imported share of Chinese in-shell peanuts increased around 10.7% in the first quarter, rising approximately to 13.7% in the second quarter and 22.2% in the third quarter. All of the seasonal dummy variables are significant for China, and most of the seasonal dummy variables are significant for the United States. The seasonal dummy variables for rest of the world are negative, but they are insignificant.

Elasticities

Conditional expenditure elasticities are reported in Table 3. Conditional expenditures of imported in-shell peanuts from China (0.97) and ROW (0.19) are inelastic, while conditional expenditure of imported in-shell peanuts from the United States (1.42) is elastic. These results suggest that, as the EU's expenditures on in-shell peanut imports increase, the EU imports more in-shell peanuts from the United States than from other sources. Expenditure elasticities are usually higher for better products or preferred grades (Tomek and Robinson). These results suggest that U.S. in-shell peanuts have better quality or are perceived as being of better quality by European consumers.

Demand for U.S. in-shell peanuts is more sensitive to income changes than demand for Chinese and ROW in-shell peanuts. These results imply that when the economy or expenditure growth slows down in the EU, this occurrence will have a larger negative impact on the demand for U.S. in-shell peanuts than the demand for in-shell peanuts from other origins. On the other hand, when the economy is growing, this incidence will have a larger positive impact on the demand

Table 3. Mean Elasticities for the Nonlinear SAIDS model of EU Import Demand for In-Shell Peanuts

		Marshallian Elasticities			Morishima Elasticities		
	Income Elasticity	China	U.S.	ROW	China	U.S.	ROW
China	0.966**	−1.743**	0.703**	0.074	–	2.254	1.449
	(0.193)	(0.330)	(0.259)	(0.166)			
U.S.	11.415**	0.893**	−1.868**	−0.441**	3.043	–	1.169
	(0.299)	(0.456)	(0.438)	(0.235)			
ROW	0.188	0.678	−0.591	−0.275	1.024	−0.282	–
	(0.426)	(0.558)	(0.489)	(0.684)			

Note: The values in parentheses correspond to standard errors calculated using bootstrapping. Superscripts ** denotes statistical significance at 5% levels.

for U.S. in-shell peanuts than the demand for in-shell peanuts from other origins.

Corresponding to the law of demand, all the Mashallian price elasticities (conditional own price elasticities) of demand for in-shell peanuts from different sources are negative (Table 3). The Marshallian own price elasticities of demand for U.S. and Chinese in-shell peanuts are −1.87 and −1.74, respectively. These high elasticity values suggest that EU consumers are highly sensitive to price changes of in-shell peanuts imported from China and the United States. Hence, if Chinese and/or U.S. exporters can work as a cartel, they may have an incentive to decrease price to raise total sales.

The Marshallian own price elasticity of demand for the ROW in-shell peanuts is less own price elastic (−0.28), but it is insignificant. This indicates that EU consumers' demand for ROW in-shell peanuts is not very sensitive to its own price changes. Something that is important to point out is the fact that only the own and cross price elasticities corresponding to the United States and China were statistically significant because China and U.S. are the main exporters of in-shell peanuts (together they account for more than 85% of the EU imports), while other countries are considered to be small exporters of in-shell peanuts.

The Marshallian own price elasticities of demand for U.S. and Chinese in-shell peanuts are very elastic, probably because China and the United States are the main exporters of in-shell peanuts to the EU. They have large volumes of export quantities of in-shell peanuts, and their export volumes are more sensitive to change in prices, while ROW has a small volume of export quantities of in-shell peanuts, and its export volumes are less sensitive to change in the price level. These high elasticity values can also be the result of the high level of disaggregation being used and the fact that in-shell peanuts are mainly used by consumers as snacks. The elasticity of the aggregate commodity composed of in-shell peanuts from different sources was also calculated using the procedure outlined in Carpio, Wohlgenant, and Safley. This elasticity measures the effect of a proportional change in the price of all types of in-shell peanuts on the aggregate quantity demanded. The elasticity for the aggregate good is estimated to be −1.00.

The Morishima elasticities of substitution were utilized to identify whether goods are substitutes or complements and to provide information on the degree of substitutability among in-shell peanuts from different sources (Table 3). The Morishima elasticities indicate that in-shell peanuts from China are substitutes for U.S. in-shell peanuts. The Morishima elasticities also indicate that in the EU market, the degree of substitutability between peanuts from China and the U.S. is higher than their degree of substitutability with in-shell peanuts from other countries. This is probably due to

Table 4. Bootstrap Estimates for the Elasticity Standard Errors of the EU Import Demand for In-Shell Peanuts

	Bootstrap Standard Errors					
	$\ell = 2$		$\ell = 4$		$\ell = 6$	
Elasticities	NLS[a]	SUR[b]	NLS	SUR	NLS	SUR
Income						
China	0.186	0.193	0.214	0.211	0.212	0.214
United States	0.296	0.299	0.319	0.311	0.340	0.351
Rest of the World	0.447	0.426	0.505	0.425	0.522	0.426
Marshallian						
China						
China	0.362	0.330	0.361	0.317	0.358	0.308
United States	0.264	0.259	0.279	0.300	0.320	0.301
Rest of the World	0.179	0.166	0.183	0.174	0.182	0.178
US						
China	0.456	0.456	0.495	0.526	0.566	0.560
United States	0.431	0.438	0.477	0.567	0.605	0.633
Rest of the World	0.273	0.235	0.265	0.246	0.314	0.275
Rest of the World						
China	0.667	0.558	0.687	0.594	0.752	0.661
United States	0.554	0.489	0.520	0.495	0.596	0.562
Rest of the World	0.706	0.684	0.725	0.729	0.732	0.723

[a] NLS= Nonlinear Least Squares.
[b] SUR= Seemingly Unrelated Regression.

the fact that China and the United States are the major exporters of in-shell peanuts to the EU markets.

Standard Errors of Elasticities

MBB estimates for the elasticity standard errors are also shown in Table 3. The standard errors were calculated using the MBB with blocks of size two and the SUR estimation method. The income elasticities based on the bootstrap standard errors were significant for the import demand for Chinese and U.S. in-shell peanuts. The Marshallian own price elasticities were significant for Chinese and U.S. in-shell peanuts.

For sensitivity purposes, Table 4 shows the MBB ($\ell = 2$) standard errors using NLS, as well as MBB standard errors using SUR, which were already presented in Table 3. Three block sizes ($\ell = 2$, $\ell = 4$, and $\ell = 6$) were included to assess the sensitivity of the results to the choice of the bootstrapping block size. MBB estimates obtained using SUR were in most cases smaller than the comparable estimates obtained using MBB and NLS. Since the NLS and SUR can be seen as Generalized Method of Moments (GMM) estimators, they both result in consistent estimates of the parameters (Greene).

The smaller values of the MBB standard errors obtained with SUR might reflect additional efficiency gains obtained by taking into account the cross equation correlations. With regard to the size of the blocks, the results were quite robust to the block size choice.

In spite of the fact that the MBB method does not assume any specific dynamic data-generating process, our empirical results show good performance of the MBB method for the calculation of the standard errors of elasticities. Some efficiency gains seem to be achievable by using SUR rather than NLS.

Summary and Conclusions

The EU is the largest importer of peanuts in the world; however, little economic research has been done on the EU markets for peanuts. The aim of this research was to estimate the import demand elasticities for in-shell peanuts in the European Union from three different sources: China, the United States, and ROW. A nonlinear source-differentiated AIDS model was used to estimate demand parameters, using data from 1991 to 2005. In the process, theoretical restrictions were also tested.

The null hypothesis of aggregation over product sources was rejected at conventional levels of significance, suggesting that peanuts from different sources are differentiated by the EU market; this can be attributed to their different quality characteristics. The expenditure elasticity for U.S. in-shell peanuts is highly elastic, which is an indicator of the superior quality of U.S. in-shell peanuts. Own price elasticities indicate that EU consumers respond more to price changes for in-shell peanuts imported from China and the U.S. than from other countries. Finally, the Morishima elasticity results indicate that in-shell peanuts from China are substitutes for U.S. in-shell peanuts and that China and U.S. in-shell peanuts have a higher degree of substitutability than other countries.

Our implementation of the MBB method for the estimation of the standard errors of the elasticities suggests that this method is suitable for estimating the reliability of elasticity estimates in nonlinear demand models. This result is important for practitioners, since currently available software used to estimate nonlinear systems of demand equations (e.g., proc model in SAS) does not provide a multivariate version of an autocorrelation heteroskedastically consistent covariance matrix that could be used to calculate asymptotic standard errors of elasticities. Even if they become available, the calculation of these standard errors in the nonlinear AIDS model is complicated by the fact that the elasticities are nonlinear functions of the parameter estimates. Given the increase in computational resources, standard errors of elasticities obtained using the MBB can be used as an alternative method to assess the reliability of elasticity estimates.

Results imply that the United States can benefit the most when there is an expansion of the EU market to import in-shell peanuts. However, demand for in-shell peanuts in Europe has been steady, while competition among exporters has changed. Therefore, maintaining strong export markets are an important priority for the U.S. in-shell peanut industry. Our findings show that the EU market differentiates in-shell peanuts from source of origin, and evidence from other research (Bliss) suggests that EU consumers perceive U.S. peanuts as being of better quality than peanuts from other sources. These findings have at least two implications. First, U.S. producers and exporters should direct efforts to ensure that in-shell peanuts exported to the EU are of the best possible quality. Second, promotion efforts should stress the quality of U.S peanuts as an advertising tool.

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