The Effect of the U.S. Foreign Market Development Program on Import Demand for Shelled Peanuts in the European Union

Tullaya Boonsaeng

Post Doctoral Associate
Department of Agricultural and Applied Economics
University of Georgia
E-mail: tullaya@uga.edu

Stanley M. Fletcher

Professor
Department of Agricultural and Applied Economics
The University of Georgia
E-mail: smf@uga.edu

Abstract

The main objective of this research is to evaluate the effectiveness of the U.S. Foreign Market Development (FMD) program on the European Union imported demand for shelled peanuts. We find that the FMD program had a positive effect on the EU demand for U.S. shelled peanuts. This result suggests that the information provided to manufactures through the FMD has helped to maintain U.S. peanuts in the EU markets. The marginal return per EURO dollars of U.S. export promotion expenditures on the FMD program is 277 EURO dollars for U.S. shelled peanuts.

Keyword: Factor demand, Shelled peanuts, U.S. Foreign Market Development Program

Selected Paper prepared for presentation at the
Southern Agricultural Economics Association Annual Meetings,
Dallas, Texas, February 2-6, 2008

Introduction

The study of European Union (EU[1]) markets for peanuts is useful for peanut exporters especially for United States (U.S.) since U.S. is one of the major suppliers to the European market. The U.S. used to be the world's largest exporter of peanuts into the EU market but now is the third largest exporter, after China and Argentina (EUROSTAT database). Moreover, the recent U.S. farm policy change in 2002 replacing the quota system by the Marketing Loan Program has affected not only U.S. peanut production but also U.S. peanut export. However, little economic research on the markets of peanuts in the EU- the largest peanut importer has been done.

The EU countries produce trivial amount of peanuts. They depend mainly on imports from Argentina, China, U.S., and the rest of the world. Their peanut imports account for around 40% of world quantity imports (FAOSTAT database 2007). The EU countries import two types of peanuts: 1) in-shell peanuts and 2) shelled peanuts. Both types are completely different with no substitutability because in shell peanuts are consumed directly by consumers but shelled peanuts are imported by manufacturers or processors used as input in the production process of final goods (e.g., peanut butter, peanut candy, peanut snack).

In the last decade, the U.S. share of the total import quantity of shelled peanuts in the EU has declined whereas China and Argentina have increased their export shares. Argentina has replaced the U.S. as the main exporter of shelled peanuts to the region. One method of increasing and/or maintaining U.S. market shares to foreign markets is done by the establishment of export promotion programs. The U.S. federal government has assisted the U.S. agricultural sector in expanding sales of agricultural products to foreign markets providing two major nonprice export promotion programs: 1) the Foreign Market Development Program (FMD) and 2) the Market

Promotion Program (MPP), which replaced the Targeted Export Assistance Program (TEA) in 1991. The promotion of U.S. agricultural exports is crucial for U.S. competitiveness.

The U.S. federal government provides export promotion funding for peanuts through the FMD and TEA/MPP programs. The TEA/MPP programs are more of brand and generic advertising to consumers whereas FMD activities tend to be more of a trade servicing or technical assistance but can also incorporate advertising to manufacturing companies in the importing countries. In this sense, the TEA/MPP program differs fundamentally from the FMD program in that the former affects the demand curve for the finished product, while the latter may affect the derived demand curve for the intermediate inputs. In this study, we focus on the effect of the U.S. FMD program on import demand for shelled peanuts in the EU.

The purpose of the FMD program for peanuts is to promote and assist U.S. peanut exports in the foreign peanut industry. Average annual expenditures for the FMD spending on the export promotion for peanuts in the EU were about $300,658 during the period of 1991 to 2001 and increased to about $383,351 during the period of 2002 to 2005, after the change in the 2002 Farm Bill. The amount of money funding for the FMD program has raised concerns about the effectiveness of the federal promotion programs. Hence, a question that naturally arises is whether these programs are effective.

The principal objective of this study is to evaluate the effectiveness of the U.S. FMD program on the EU import demand for shelled peanuts. The specific objectives are 1) To econometrically estimate a system of factor demand equations incorporating the effects of FMD promotion for imported shelled peanuts into the EU in a way that maintains the theoretical demand restrictions of adding up, homogeneity, and symmetry; 2) To measure the effectiveness of the FMD program on the EU import demand for shelled peanuts: 3) To use the estimated import demand parameters to provide empirical measures of the sensitivity of demand to change in total imports, own price, and the prices of cross country substitutes; and 4) To evaluate the competitiveness between U.S., Argentinean, and Chinese peanuts in the EU markets.

The effectiveness of export promotion programs has been examined on various agricultural commodities in importing countries. For example, studies have been done on red meat (Le, Kaiser, & Tomek, 1997), beef (Goddard and Conboy, 1993), pecans (Onunkwo and Epperson, 2000); almonds (Halliburton and Henneberry, 1995), and apples (Richards, Van Ispelen, and Kagan, 1997). These studies on export promotion programs have focused on their effects on consumer demands through change in taste.

However, many agricultural goods are demanded not by foreign consumers, but by firms, as intermediate inputs in a production process of final goods (Davis and Jensen, 1994). A few studies looked at promotion at the firm level rather than the consumer (e.g., Ehrlich and Fisher, 1982; Richards and Patterson, 1998; Richards, 1999). Ehrlich and Fisher (1982) treated promotion as a capital input to the firm. Richards (1999) showed that stocks of consumer information are indeed quasi-fixed input to the household production process. Richards and Patterson (1998) treated export promotion as an input to U.S. producers' export supply decision.

Promotion by the firms may be viewed in many ways. Nelson (1974) viewed promotion as information providing the characteristics of search goods or the quality of experience goods. Richards and Patterson viewed promotion as an exporter's investment in establishing and maintaining a product's image in a foreign market. Based on the idea of Stigler and Becker (1977), promotion may be durable as it represents an investment by a household in improving its production technology (Richards, 1999). Nerlove and Arrow (1962) argued that firms do not simply use promotional funds but rather invest them in a long-lived asset interpreted as either goodwill or brand equity. In this study, promotion is viewed as information providing to manufacturers (importer) rather than promotion changes consumer tastes.

Our model differs from previous studies. We treat the FMD program as an information input in the production function of manufacturing companies in the importing country. This information input provides information on quality, price, texture, flavor, size, and product availability of U.S. peanuts for the EU peanut manufactures. EU firms can choose shelled peanuts from different sources. Then, the decision of the EU peanut industry (sum of all firms) based on their information is to buy shelled peanuts from different sources used in the production process. Hence, the proportion of shelled peanuts from different sources is changed but the total amount of peanuts used in the process is relatively stable.

A differential factor allocation model (DFAM) incorporating information input is utilized for estimation purposes under an assumption of output-homogenous production technology and input-output separability. In analyzing the input demand for imported commodities, it is quite often that there is limitation in finding the data especially international trade data or the data is unavailable. Therefore, we assume that the firm has the input-output separable forms. This implies that changes in output of processed peanuts have no effects on the cost minimizing total input decision of shelled peanuts at given input prices. This assumption allows you to estimate the input demand for imported goods without knowing the output price of processed peanuts.

General Information on U.S. Peanuts

Peanuts may be considered as a minor crop on a national level but they constitute an important commodity to Southern agricultural and in many rural economies. In addition, peanuts are grown from Virginia to New Mexico with some production in other part of the U.S. since the change in the peanut program in the 2002 Farm Bill. The U.S. is the world's third-leading peanut producer (ERS, USDA). Farm production value averaged approximately 1 billion dollars during marketing years 1996-2001. After marketing quotas were eliminated it fell to just 605 million dollars in 2002, before climbing to about 800 million dollars annually between 2003 and 2005.

U.S. peanut exports averaged around 700 to 900 million pounds during marketing years 1991-2001. After marketing quotas were eliminated it dropped down to around 500 million pounds annually between 2002 and 2005. Prior to 2002, peanut producers were supported by the peanut quota program. Peanuts grown under quota received a fixed loan rate. Peanut production above the quota was designated for the export or the domestic crushing markets and peanut producers received a significantly lower loan rate. Changes to the peanut program in the 2002 may have diminished export incentives, as domestic producers who formerly produced additional peanuts for export can now market their peanuts domestically weaking export of shelled peanuts.

The total domestic use of shelled peanuts composed of peanut butter products, peanut candy, snack peanuts and other shelled use increased over time from 1,534.30 million pounds in 2002 to 1797.42 million pounds in 2005 (Peanut Stocks and Processing, NASS, USDA). The total shelled peanut exports from U.S. dropped from 197,147.90 metric ton in 2002 to 124,417.40 metric ton in 2005 (Foreign Trade Statistics, USDA). Exports fell almost 37% between these two periods. However, U.S. domestic production and export volume of peanut butter have significantly increased after the change of the program.

Background Information on World Peanut Trade

According to the Production, Supply, and Distribution (PSD online) database, (FAS, USDA), the main suppliers of peanut exports are Argentina, China and U.S.. These three countries account for 70% of total quantity exports in the world peanut markets. In 2005, the world total quantity export of peanuts was 2,005 thousand metric tons. Within this amount, Argentina exported 400 thousand metric tons of peanuts, China exported 784 thousand metric tons of peanuts, and U.S. exported 223 thousand metric tons of peanuts. The main importers of peanuts are Canada, European Union (EU), Japan and Mexico which account for more than 60% of total import quantities. Canada, Japan and Mexico each account for 7-8% of total world import quantities and EU accounts for around 40% of total world import quantities in 2005.

China, U.S., and Argentina are the major shelled peanut exporting countries into the EU accounting for 85% of EU import quantity during 1988 to 2005. However, their share has been changing over time. The U.S. used to be the world's largest exporter of shelled peanuts into the EU market but now is the third largest exporter, after China and Argentina.

Total quantity of shelled peanut imported by the EU countries was 336.02 thousand metric tons in 1988, slightly increasing until it reached 431.49 thousand metric tons in 1996. Then it slightly declined over time and it was down to 356.94 thousand metric tons in 1999. It started to go up again. The total import volume of shelled peanut was about 454 thousand metric tons in 2005. Overall, the total amount of export volume did not increase significantly. Hence, the changes in export markets are more likely due to the changes in market share among exporting countries.

Trade disputes such as tariff and quota on imported peanuts and peanut products are negligible barriers among European countries. Only food safety is the main concerned among EU consumers especially the level of aflatoxin (Fletcher and Smith, 2000). The EU countries randomly test all imported peanuts coming from export countries, but peanuts from certain origins (i.e. China) have higher mandated testing. Any peanuts coming into the EU countries that do not meet their strict standards are further processed and then retested, returned to country of origin, or in some cases destroyed. Since food safety is the major concern among EU consumers, the degree of food safety could become, to some extent, a source of product differentiation. Sanders found that peanuts from different sources have different quality attributes (Bliss, 2005). Hence, it is important to recognize quality differences among peanut exporters when analyzing the EU peanut import demand.

Input Demand Model Incorporating Information Input

The differential approach proposed by Latinen and Theil (1978) and Laitinen (1980) for input demand has been studied by a few people (Rossi, 1984; Washington and Kilmer, 2002; Livanis and Moss, 2006). Rossi extended Laitinen and Theil's work by including fixed factors of production on the Italian agricultural sector and assumed that production technology separable in the fixed inputs. Washington and Kilmer compared the consumer demand derived from the Rotterdam model to the factor demand derived from the differential production approach on the application of imported whey in Japan. They also utilized this differential production approach to estimate imported demand for cheese in Hong Kong. Livanis and Moss generalized the Laitinen and Theil model to account for quasi-fixed inputs with no restrictions on the firm's technology.

Our model follows Laitinen and Theil's work (1978) taking into account the information input[2], in which the industry[3]'s objective is to minimize variable cost $\sum_i w_i x_i$ subject to the production constraint by varying any $x_i \in \mathbf{x}$ for a given positive output and $w_i \in \mathbf{w}$ where $\mathbf{x} = (x_1, ..., x_n)'$ and $\mathbf{w} = (w_1, ..., w_n)'$ are the quantity and price vector of n inputs. Production function incorporating information input variable is represented by the following equation.

(1) $$h(\mathbf{x}, \mathbf{q}, \mathbf{a}) = 0$$

where $\mathbf{q}$ is the homogenous output with a vector of m outputs $\mathbf{q} = (q_1,..., q_r, q_{r+1,}..., q_m)'$, and $\mathbf{a} = [a_1,..., a_l]$ is a vector of the information input providing by l exporting countries.

The short run problem of the industry is given by the Lagrangean function as:

(2) $$L(q,\rho) = \sum_{i=1}^{n} w_i x_i - \lambda h(x,q,a)$$

Differentiating equation (1) with respect to $\log x_i$, we get the solution of the first order condition $w_i x_i - \lambda \, \partial h / \partial \log x_i = 0$ where $i = 1, \ldots, n$.

Based on the first order condition, the optimum values of the inputs can be written as functions of input prices, output quantities, and information inputs:

(3) $$\mathbf{x}_i = x_i(\mathbf{q}, \mathbf{w}, \mathbf{a}), \qquad i = 1, \ldots, n.$$

In order to express changes in the inputs in terms of changes in the outputs, the input prices, and the information inputs, the differential of equation (3) is taken with respect to $\log \mathbf{q}$, $\log \mathbf{w}$, and $\log \mathbf{a}$. Hence, the differential of the demand for the n inputs is as followed:

(4) $$d(\log \mathbf{x}) = \frac{\partial \log \mathbf{x}}{\partial \log \mathbf{q}'} d(\log \mathbf{q}) + \frac{\partial \log \mathbf{x}}{\partial \log \mathbf{w}'} d(\log \mathbf{w}) + \frac{\partial \log \mathbf{x}}{\partial \log \mathbf{a}'} d(\log \mathbf{a})$$

For the values of $\partial \log \mathbf{x} / \partial \log \mathbf{q}'$, $\partial \log \mathbf{x} / \partial \log \mathbf{w}'$, and $\partial \log \mathbf{x} / \partial \log \mathbf{a}'$, we take the total differentiate the equations of the solution from the first order condition in equation (2) and the production function in output homogeneous form in equation (1) with respect to $\log q_r$, $\log w_i$, and $\log a_i$ to determine how the optimum changes in response to changes in these given variables. The solution of the industry written in matrix equation is as followed:

(5) $$\begin{bmatrix} \mathbf{F}^{-1}(\mathbf{F} - \gamma \mathbf{H}_1)\mathbf{F}^{-1} & \boldsymbol{\iota}_n \\ \boldsymbol{\iota}_n' & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log \mathbf{q}'} & \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log \mathbf{w}'} & \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log \mathbf{a}'} \\ -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log \mathbf{q}'} & -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log \mathbf{w}'} & -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log \mathbf{a}'} \end{bmatrix} = \begin{bmatrix} \gamma \mathbf{F}^{-1}\mathbf{H}_2 - \mathbf{I} & \gamma \mathbf{F}^{-1}\mathbf{H}_3 \\ \gamma \mathbf{g}' & \mathbf{0} & \gamma \boldsymbol{\pi}' \end{bmatrix}$$

where $\mathbf{F} = \text{diag}(f_1, f_2,..., f_n)$, $\mathbf{g}' = (g_1,..., g_r,..., g_m)'$, $\boldsymbol{\pi}' = (\pi_1,...,\pi_k,...,\pi_l)'$, $\boldsymbol{\iota}_\mathbf{n}$ is an $n\times 1$ unit vector, $f_i = w_i x_i \big/ \sum_{i=1}^{n} w_i x_i$, $g_r = -\partial h(\cdot)/\partial \log z_r$, $\pi_k = -\partial h(\cdot)/\partial \log a_k$, $\gamma = \lambda \big/ \sum_{i=1}^{n} w_i x_i$, and

$$\mathbf{H}_1 = \left[\frac{\partial^2 h}{\partial \log x_i \partial \log x_j}\right]_{n\times n}, \mathbf{H}_2 = \left[\frac{\partial^2 h}{\partial \log x_i \partial \log q_r}\right]_{n\times m}, \mathbf{H}_3 = \left[\frac{\partial^2 h}{\partial \log x_i \partial \log a_k}\right]_{n\times l}$$

Next, define $\boldsymbol{\Theta} = [\theta_{ij}] = (1/\psi)\mathbf{F}(\mathbf{F} - \gamma\mathbf{H}_1)^{-1}\mathbf{F}$ be symmetric positive definite $n\times n$ matrix where the positive scalar ψ is defined by $\psi = \boldsymbol{\iota}_\mathbf{n}'\mathbf{F}(\mathbf{F} - \gamma\mathbf{H}_1)^{-1}\mathbf{F}\boldsymbol{\iota}_\mathbf{n}$, and $\boldsymbol{\theta} = \boldsymbol{\Theta}\boldsymbol{\iota}_\mathbf{n}$ be the four element vector obtained from the row sum of $\boldsymbol{\Theta}$. Hence, the solution of equation (5) are:

$$\text{(6)} \qquad \begin{bmatrix} \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log \mathbf{q}'} & \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log \mathbf{w}'} & \mathbf{F}\dfrac{\partial \log \mathbf{x}}{\partial \log a} \\ -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log \mathbf{q}'} & -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log \mathbf{w}'} & -\dfrac{\partial \log \boldsymbol{\lambda}}{\partial \log a} \end{bmatrix} = \begin{bmatrix} \boldsymbol{\psi}(\boldsymbol{\Theta} - \boldsymbol{\theta}\boldsymbol{\theta}') & \boldsymbol{\theta} \\ \boldsymbol{\theta}' & -1/\psi \end{bmatrix} \begin{bmatrix} \gamma\mathbf{F}^{-1}\mathbf{H}_2 - \mathbf{I} & \gamma\mathbf{F}^{-1}\mathbf{H}_3 \\ \gamma\mathbf{g}' & \mathbf{0} & \gamma\boldsymbol{\pi}' \end{bmatrix}$$

Premultiply equation (4) by $\mathbf{F}$ and use the solution in equation (6), equation (4) can be written in the following form.

$$\text{(7)} \qquad \mathbf{F}d(\log \mathbf{x}) = (\gamma\boldsymbol{\theta}\mathbf{g}' + \gamma\psi(\boldsymbol{\Theta} - \boldsymbol{\theta}\boldsymbol{\theta}')\mathbf{F}^{-1}\mathbf{H}_2)d(\log \mathbf{q}) - \psi(\boldsymbol{\Theta} - \boldsymbol{\theta}\boldsymbol{\theta}')d(\log \mathbf{w})$$
$$+ \ (\gamma\boldsymbol{\theta}\boldsymbol{\pi}' + \gamma\psi(\boldsymbol{\Theta} - \boldsymbol{\theta}\boldsymbol{\theta}')\mathbf{F}^{-1}\mathbf{H}_3)d(\log \mathbf{a})$$

Let $\mathbf{g}' = \boldsymbol{\iota}_m'\mathbf{G}$ with $\mathbf{G} = \text{diag}(g_1,..., g_m)$, $\boldsymbol{\pi}' = \boldsymbol{\iota}_l'\mathbf{A}$ with $\mathbf{A} = \text{diag}(\pi_1,...,\pi_l)$, $\theta_i^r = (\partial w_i x_i/\partial q_r)/(\partial C/\partial q_r)$ is the share of the ith input in the marginal cost of the rth product, and $\xi_i^k = (\partial w_i x_i/\partial a_k)/(\partial C/\partial a_k)$ is the share of the ith input in the shadow price of information input kth. Then, the coefficients in equation (7) of $d\log q$ and $d\log a$ are equal to $\gamma[\theta_i^r]\mathbf{G}$ and $\gamma[\xi_i^k]\mathbf{A}$, respectively. Hence, the equation (7) becomes:

$$\text{(8)} \qquad \mathbf{F}d(\log \mathbf{x}) = \gamma[\theta_i^r]\mathbf{G}d(\log \mathbf{q}) - \psi(\boldsymbol{\Theta} - \boldsymbol{\theta}\boldsymbol{\theta}')d(\log \mathbf{w}) + \gamma[\xi_i^k]\mathbf{A}d(\log \mathbf{a})$$

For the ith, equation (8) takes the form as:

(9) $$f_i d(\log x_i) = \gamma \sum_{r=1}^{m} \theta_i^r g_r (\log q_r) - \psi \sum_{j=1}^{n} (\theta_{ij} - \theta_i \theta_j) d(\log w_j) + \gamma \sum_{k=1}^{l} \xi_i^k \pi_k d(\log a)$$

Equation (9) can be called the *ith* differential demand equation which describes the change in the demand for the *ith* input, measured by the quantity component of the change in the *ith* factor share, in terms of output changes, input price changes, and information input changes.

Data

The data used to estimate the model are quarterly time series data from 1991 to 2005. The sources of peanuts considered are Argentina, China, U.S., and the rest of the world. The quantity of imports from each source is measured in 100 kilogram (kg), and the value of imports is measured in EURO dollars. Import price data is not available to obtain so unit prices[4] are used as approximate of import price. The data were obtained from several sources published by EUROSTAT. The data for EU15 CPI energy used as energy price and EU15 manufacturing hourly earnings used as labor cost are from SourceOECD Main Economic Indicators. The U.S. dollar export promotion expenditures on the FMD program for peanuts in the EU are from the American Peanut Council[5] (APC) in which these data is not publicly available.

The APC provides only annual data on the U.S. dollar export promotion expenditures. The U.S. dollar export promotion expenditures on the EU were converted to the EURO dollar export promotion expenditures by multiplying exchange rate between U.S. and the EU (U.S. dollars to one EURO dollar). Unfortunately, the data for this exchange rate is only available after 1998. Therefore, we construct the exchange rate between U.S. and the EU by multiplying the exchange rate between U.S. and UK by the exchange rate between UK and the EU. Exchange rate between U.S. and UK (U.S. dollars to one British pound) is from the Federal Reserve Bank of St. Louis and is available online. Exchange rate between UK and the EU (British pound to one

EURO dollar) is from EUROSTAT database. An interpolation method was utilized to produce quarterly time series of the EURO dollar export promotion expenditures from the available annual time series. Interpolation methods allow producing a time series at a higher frequency that is actually available; for example, a quarterly series from yearly data.

Peanut production in the EU is not included since the EU produces only a trivial amount of peanuts, and peanut processors depend on peanut import from different sources. Hence, domestic production can be ignored in this study because their peanut production is infinitesimal relative to the amount of their peanut import[6].

Empirical Estimation

For simplicity, we assume that the peanut industry has the input-output separable forms. Let $\theta_i d(\log X) = \gamma \sum_{r=1}^{m} \theta_i^r g_r (\log q_r)$ [7]. Hence, the econometric model of the ith differential factor demand equation of the industry in equation (9) can be written in the simpler form as:

$$(10) \qquad f_i d(\log x_i) = \theta_i d(\log X) - \sum_{j=1}^{n} \theta_{ij} d(\log w_j) + \sum_{k=1}^{l} \mu_{ik} d(\log a_k),$$

where $f_i = p_i q_i / C$ is the share of the ith factor as the proportion of total cost C, $d(\log X) = \sum_{i=1}^{n} f_i d(\log x_i)$ is the Divisia index which measures the change in quantities, $d(\log w_j)$ measures the change in input prices, and $d(\log a_k)$ measures the change in information input.

The factor demand in equation (10) is the solution of a source differential factor allocation model (DFAM). The change in factor demand for ith input involves three terms: 1) the Divisia volume index of inputs $d(\log X)$, 2) the changes in input price $d(\log w_j)$, and 3) the changes in information input $d(\log a_k)$. The inputs are independent of the changes in individual outputs. As a result, changes in output play no role in the total input decision. In analyzing the factor demand for imported commodities, it is quite often that there is limitation in finding the data especially international trade data. The model in equation (10) allows you to estimate the system of factor demand equations without knowing information on output.

To be consistent with economic theory, the system of input demand must satisfy the following input demand restrictions. Adding up implies the following restrictions in the parameters ($\sum_{s=1}^{n}\theta_s = 1;\ \sum_{s=1}^{n}\theta_{sj} = 0;\ \sum_{s=1}^{n}\mu_{sk} = 0$), homogeneity implies ($\sum_{s=1}^{n}\theta_{sj} = 0$), and symmetry implies ($\theta_{ij} = \theta_{ji}$).This restriction ($\sum_{s=1}^{n}\mu_{sk} = 0$) implies that the proportion of shelled peanuts from different sources is changed but the total amount of peanuts used in the process is relatively stable.

The conditional own price and cross price elasticities of the factor source differentiated demand model are $\varepsilon_{ij} = \theta_{ij} / f_i$ when $i = j$ for the own price elasticities and $i \neq j$ for the cross price elasticities. The own price elasticities are expected to be negative. For the cross price elasticities, if θ_{ij} is negative (positive), ith and jth inputs are specific complements (substitutes).

The Divisia index elasticity is $\eta_i = \theta_i / f_i$. When η_i is greater one, the industry's use of the ith input increases more rapidly than the industry's average input. Similarly, when η_i is between zero and one, the industry's use of the ith input increases when average input does, but not so quickly. In general, the Divisia import elasticity shows the percentage change in a country's exports that are imported into another country given a one percent change in the importing country's total imports.

The information input elasticities (export promotion elasticities) (ρ_{ij}) are μ_{ik} / f_i. When μ_{ik} has positive value, it implies that the export promotion program has positive effect on ith market shares in the import markets. On the other hand, when μ_{ik} has negative value, it implied that the export promotion program has negative effect on ith market shares in the import markets.

The information input is measured as EURO dollars spent on FMD by the U.S. in the EU market. The U.S. is the only country that is funding an export promotion program in Europe. The other export counties do not have any types of export promotion for peanuts in Europe. The additional explanatory variables for the conditional factor demand in equation (10) are labor cost, energy price, seasonal dummy variables and a dummy variable to capture the effect of farm bill 2002 (2002:4-2005:4). Hence, the empirical model of the conditional factor demand system used for estimation in study is follows:

$$(11) \qquad \bar{f}_{it} d(\log x_{it}) = \theta_i d(\log X_t) - \sum_{j=1}^{4} \theta_{ij} d(\log w_{jt}) + \mu_{us} d(\log a_{ust}) + \omega_i d \log \mathrm{Pw}_t + e_i d \log \mathrm{Pe}_t$$
$$+ \sum_{v=1}^{3} d_v D_{vt} + d_f FB_t + \varepsilon_{it},$$

where $\bar{f}_{it} = (f_{it} + f_{it-1})/2,$ t indexes time (1991:1-2005:4), a_{us} is EURO dollars spent on FMD by U.S. in the EU market, Pw is labor cost, Pe is energy price, D_v is the seasonal dummy variable, FB is the farm bill dummy variable, and ε_i is the error term.

The conditional factor demand system represented by equation (11) contains four equations (i = Argentina, China, U.S., and ROW). The ROW equation for shelled peanuts is dropped to avoid singularity problems since the factor shares in the conditional factor demand system sums to one. The parameters of the conditional factor demand system after imposing homogeneity and symmetry were estimated by the seemingly unrelated regression method (SUR) in order to take into account the cross-price effects on source-differentiated within the input.

Results

A description and simple statistics for the variables (quantities, values, and US export expenditures on the FMD program) are presented in table 1. A test of autocorrelation is constructed on the system a whole by using the Breush-Godfrey (BG) systemwise test (Shukur, 2002). The test is done using multivariate F-test proposed by Rao. Results of BG systemwise test indicated that there is no presence of autocorrelation in a system of DFAM model where the P-value equals 0.84 because the estimation of the DFAM is estimated at the first difference of the log of variables and it is corrected for autocorrelation. Homogeneity and symmetry are tested using a likelihood ratio (LR) test. Results indicate that we could not reject the null hypothesis that homogeneity and symmetry are satisfied at 5 percent level of significance (P-value = 0.0514).

Parameter estimates

Conditional differentiated factor demand parameter estimates for EU imports of shelled peanuts are shown in table 2. Own-price parameter estimates are negative as to be expected and are significant for Argentina, China, and U.S.. The estimates of the marginal factor shares are significant for all equations and they are positive indicating that as total imports increase, imports from each source country also increase as well.

Most of the cross price coefficients are significant except for the cross price coefficient between Argentina and U.S. in the imported factor demand equation for Argentinean shelled peanuts, and the cross price coefficient between U.S. and rest of the world in the imported factor demand equation for U.S. shelled peanuts. The cross price coefficients indicate that imported shelled peanuts from U.S., China, and Argentina are substitutes in the EU markets. Only imported shelled peanuts from China and rest of the world are compliment in the EU markets.

The effect of energy price index variable is insignificant for all imported demand equations. The labor price index variable has a negative effect and significant for imported demand for Chinese shelled peanuts because people who have low wage tend to buy low quality peanuts and Chinese peanuts are considered to be low quality and have lower price. However, this variable has a positive effect for imported demand for U.S. shelled peanuts because people who have high wage tend to buy high quality peanuts and U.S. peanuts are considered to be high quality. For Argentinean peanuts, the labor price index variable has a positive effect but it is insignificant.

Dummy variables measuring the effects of seasonality show that imported demand for U.S. shelled peanuts is high in the second quarter. High imported demand of U.S. shelled peanuts in second quarter might be due to sport events during summer time but it is insignificant. Moreover, imported demand for U.S. shelled peanuts is low in the first and third quarter. This result indicates that imported demand for U.S. shelled peanuts is high in the fourth quarter which coincides with the harvesting season of peanuts in the U.S. from September to November and the higher consumption demand for the processed peanut and peanut snack during the holiday period.

The effects of seasonality show that import demand for Argentina shelled peanuts is low in the first and second quarter but it is high in the third quarter because the harvesting season of peanuts in the Argentina starts in April. All the effects of seasonality in the Argentina equation are significant. In contrast to imported demand for Argentinean peanuts, the effects of seasonality show that imported demand for Chinese peanuts is high in the first, second, and third quarter which do not coincide with the harvesting season from October to December. This indicates that peanuts in China are stored and sold during off reason. The seasonal dummy variables in the China equation are positive and significant in first and second quarter.

The dummy variable included to capture the 2002 Farm bill which eliminated the marketing quota system for peanuts was found to have negative effect on imported demand for U.S. shelled peanuts but the coefficient is insignificant. It might indicate a potential negative effect on U.S. peanut exports to EU because U.S. producers who formerly produced additional peanuts for export can now market their peanuts domestically.

Results in table 2 also indicate the export promotion (U.S. FMD expenditure) has a statistically significant positive effect on the imported factor demand for U.S. shelled peanuts. This suggests that U.S. export promotion expenditures on the FMD program would help to increase EU imported demand for U.S. shelled peanuts. While the U.S. FMD expenditure has a statistically significant negative effect on the imported factor demand for Argentina shelled peanuts and has a negative effect on the imported factor demand for Chinese shelled peanuts but it is insignificant. This indicates that U.S. export promotion expenditures on the FMD program would decrease EU imported demand for Argentinean and Chinese shelled peanuts. As a result, the information provided to manufacturers through the FMD has helped to maintain U.S. shelled peanuts in the EU markets.

Elasticities

Divisia index and price elasticities evaluated at the factor mean are presented in table 3. The Divisia index elasticities are 0.4951, 1.1537, 1.4791, and 0.7518 for Argentina, China, U.S., and rest of the world, respectively. With the exception of the rest of the world, all of the Divisia index elasticities are significant at the 5% level. This indicates that if total shelled peanuts imported into EU increase by 1.0%, shelled peanuts export to EU from these countries will increase by 0.4951%, 1.1537%, 1.4791%, and 0.7518%, respectively. Therefore, the biggest beneficiary when total shelled peanuts imports increase into EU markets is the United States, following by China, rest of the world, and Argentina.

King (1979) and Tweeten (1983) have argued that economists often rely on a value of zero for the null hypothesis of demand elasticities. They suggested use of other values, such as 1.0 for demand elasticities because this point is well suited defining the type of commodities. Therefore, we perform a test for the null hypothesis that the Divisia index elasticity is equal to one. Using the results in table 3, the calculated t-statistic is 0.70 for China, and 1.85 for U.S.. This result suggests that the Divisia index elasticity is less than or equal to one for China, but the Divisia index elasticity is greater than one for U.S..

The own-price elasticities for shelled peanuts from different sources are negative corresponding to the law of demand. The own price elasticities of demand for Argentina shelled peanuts are -2.1066, for Chinese shelled peanuts -2.2203, and for U.S. shelled peanuts -1.7840. They are elastic and significant. These results imply that shelled peanuts from Argentina and China and imported into the EU are more sensitive to a price change than shelled peanuts from U.S.. Hence, Chinese and Argentina exporters may have incentive to decrease price to raise total sales.

The cross-price elasticities indicate that shelled peanuts from Argentina, China, and U.S. are substitute. Furthermore, the cross price elasticities between Argentina and China have a high degree of substitutability as well as the cross price elasticities between China and U.S.. The cross price elasticities of U.S./China and Argentina/China are significant and their values are 1.1723 and 1.2166, respectively. These results indicate that if the price of China shelled peanuts increase by 1 percent, the quantity demanded for U.S. shelled peanuts into the EU will increase by 1.1723%, and the quantity demanded for Argentina shelled peanuts exported into the EU will increase by 1.2166%. This suggests that Argentina gain a little bit more than U.S. when China price for shelled peanuts increases.

In addition, the cross price elasticities of Argentina/U.S. and China/U.S. are 0.2463 and 1.2927, respectively. These results suggest that China gain more than Argentina when U.S. price for shelled peanuts increases. The cross price elasticities of China/Argentina and U.S./Argentina are 1.3187 and 0.2421, respectively. These results suggest that China will gain more than U.S. when Argentina price for shelled peanuts increases.

All export promotion elasticities are calculated at the factor mean showed in table 3. The export promotion elasticities for Chinese shelled peanuts are found to be insignificant. This implies that U.S. export promotion expenditures on the FMD program did not have an impact on imported demand for Chinese shelled peanuts. The export promotion elasticities of EU imported demand for U.S. shelled peanuts have a positive effect while the export promotion elasticities for Argentinean shelled peanuts have a negative effect. The export promotion elasticities for U.S. and Argentinean shelled peanuts are found to be significant.

Using the export promotion elasticities in table 3, the marginal return to promotion expenditures can be obtained by multiplying promotion elasticity by the ratio of mean imported peanut expenditures to mean promotion expenditures in that country (Halliburton and Henneberry, 1995; Richards, Van Ispelen and Kagan, 1997). Thus, the marginal return per EURO dollars of U.S. export promotion expenditures on the FMD program is 277 EURO dollars for U.S. shelled peanuts. The high rate of return for U.S. shelled peanuts is due to the fact that U.S. export promotion expenditure on the FMD program is only 0.42 percent of the total imported value of U.S. shelled peanuts during years 1991-2005.

Conclusion

This paper examines the effect of the U.S. FMD program on U.S. peanut exports to the EU market. Furthermore, this study provides an economic analysis on the import demand for shelled peanuts in the EU. A factor demand incorporating the effects of FMD promotion for import demand for shelled peanuts in the EU was developed. The FMD promotion is modelled as an information input and exogenous factor to the factor demand. A system of factor demands was estimated for shelled peanuts from Argentina, China, and U.S., using the data from 1991 to 2005.

The results of Divisia index elasticities for imported shelled peanuts show that, U.S. is the biggest beneficiary of export shelled peanuts to the EU markets when EU's total imports of shelled peanuts increase. A high value of Divisia index elasticity is associated with high quality of peanuts because the Divisia elasticity indicates a similar relationship as the conditional expenditure elasticity.

The values of the Divisia index elasticity are helpful to analyze the effects of the change in total imported shelled peanuts into the EU. For example, if the total shelled peanuts import to EU increase by 10% holding all price constant, the shelled peanuts export from the U.S. will increase by 14.79%. Hence, the additional U.S. shelled peanuts needed to meet that demand would be about 8.336 million kg based on total US exports to EU in 2005. Given that U.S. average peanut yield is approximately 1358.6 kg per acre; U.S. producers would need to plant an additional 6135 acres of peanuts. This information would certainly benefit the U.S. peanut industry.

Conditional own-price elasticities indicate that imported shelled peanuts from Argentina and China are more sensitive to a price change than shelled peanuts from U.S.. Conditional cross-price elasticities indicate that Argentina and China shelled peanuts are substitutable for the U.S. shelled peanuts. This indicates that U.S., Argentina and China are competitive exporters for EU shelled peanut imports. Moreover, Argentinean shelled peanuts are more competitive when Chinese price for shelled peanuts increases and Chinese shelled peanuts are more competitive when U.S. and Argentinean prices of shelled peanuts rise.

The U.S. is the most benefit from the growth of in the EU when there is expansion of the EU market of import shelled peanuts. However, demand for shelled peanuts in Europe has been steady, while competition among exporters has changed. Therefore, maintaining strong export markets is an important priority for the U.S. peanut industry. Export promotion programs and product differentiation may be the marketing strategies to help boost the demand for U.S. peanuts so that U.S. peanut industry could remain strong in a competitive market for peanuts because U.S. peanuts have a higher quality. Remain high quality helps to keep U.S. peanuts in the market when manufacturers and retailers had strong incentives to switch to other origins. This has been done by “Innovation Through Quality” program.

Based on the findings of the study, the export promotion (U.S. FMD expenditure) has a statistically significant positive effect on the imported factor demand for U.S. shelled peanuts. This suggests that U.S. export promotion expenditures on the FMD program would help to increase in EU imported demand for U.S. shelled peanuts. The marginal return rate per EURO dollars of U.S. export promotion expenditures on the FMD program is 277 EURO dollars for U.S. shelled peanut. As the result, the U.S. peanut industry should get benefit substantially from increased export promotion on the FMD program in the EU.

Footnotes

[1] The countries included in the European Union members are Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Sweden. It can be called EU15.

[2] Information input does not change the total amount of input $(\sum_{i=1}^{n} x_i)$ but the information input changes the proportion of each input (x_i) used in the production process.

[3] The industry is the sum of all peanut firms producing peanut butter, peanut snack, and peanut candy.

[4] Unit prices of imported shelled peanuts from each country are computed by dividing total value by total quantity of imports.

[5] The export promotion data is from personal communication and contract with American Peanut Council in 2007.

[6] The EU production is less than 0.0001 percent of total world production and is less than 0.01 percent of total EU import of peanuts. The data of EU and world peanut production are available at Production, Supply and Distribution (PSD online).

[7] More detail about derivation can be found with Laitinen and Theil (1978), and Laitinen (1980).

Reference:

Ahmadi-Esfahani, F.Z. "Estimation of Price Elasticities of export demand for Canadian and U.S. Wheat: A Non-traditional Approach." *Canadian Journal of Agricultural Economics* 37 (1989): 173-190.

Bliss, R.M. "Taste Tests Prove it; U.S. Peanuts are Tops." Agricultural Research Magazine, USDA, August 2005.

Davis, G.C. and K.L. Jensen. "Two-Stage Utility Maximization and Import Demand Systems Revisited: Limitations and an Alternative." *Journal of Agricultural and Resource Economics* 19 (1994): 409-424.

Ehrlich, I. and L. Fisher. "The Derived Demand for Advertising: A Theoretical and Empirical Investigation." *The American Economic Review* 72 (1982): 366-388.

Fletcher, S.M. and N. Smith. "Leaflet4: Peanuts and the World Trade Organization." Center for North American Studies, Department of Agricultural Economics, The Texas A&M University System, 2000.

Goddard, E.W. and P. Conboy. "Optimal International Promotion Expenditure for Differentiated Products." *Review of Marketing and Agricultural Economics* 61 (1993): 49-61.

Halliburton, K. and S.R. Henneberry. "The Effectiveness of U.S. Nonprice Promotion of Almonds in the Pacific Rim." *Journal of Agricultural and Resource Economics* 20 (1995): 108-121.

King, R.A. "Choices and Consequences." *American Journal of Agricultural Economics* 61(1979): 839-848.

Laitinen, K. *The Theory of the Multiproduct Firm*, New York: North-Holland Publishing Company, 1980.

Laitinen, K. and H. Theil. “Supply and Demand of the Multiproduct Firm.” *European Economic Review* 11 (1978): 107-154.

Le, C.T., H.K. Kaiser, and W. Tomek. “Export Promotion and Import Demand for US Red Meat in Selected Pacific Rim Countries.” *Agribusiness* 14 (1997): 95-105.

Livanis, G. and C.B. Moss. “Quasi-Fixity and Multiproduct Firms.” *Economics Letters* 93 (2006): 228-234.

Nelson, P. “Advertising as Information.” *The Journal of Political Economy* 82 (1974): 729-754.

Nerlove M. and K.J. Arrow. “Optimal Advertising Policy under Dynamic Conditions.” *Economica* 29 (1962): 129-142.

Onunkwo, I.M. and J.E. Epperson. “Export Demand for U.S. Pecans: Imports of U.S. Export Promotion Programs.” *Agribusiness* 16 (2000): 253-265.

Richards, T.J. “Dynamic Model of Fresh Fruit Promotion: A Household Production Approach.” *American Journal of Agricultural Economics* 81 (1999): 195-211.

Richards, T.J. and P.M. Patterson. “Dynamic Complementarity in Export Promotion: The Market Access Program in Fruits and Vegetables.” *Journal of Agricultural and Resource Economics* 23 (1998): 319-337.

Richards, T.J., P. Van Ispelen, and A. Kagan. “A Two-Stage Analysis of the Effectiveness of Promotion Programs for U.S. Apples.” *American Journal of Agricultural Economics* 79 (1997): 825-837.

Rossi, N. “The Estimation of Product Supply and Input Demand by the Differential Approach.” *American Journal of Agricultural Economics* 66 (1984): 368-375.

Shukur, G. “Dynamic Specification and Misspecification in Systems of Demand Equations: A Testing Strategy for Model Selection.” *Applied Economics* 34 (2002): 709-725.

Stigler, G.J. and G.S. Becker. “De Gustibus Non Est Disputandum.” *The American Economic Review* 67(1977): 76-90.

Tweeten, L. “Hypotheses Testing in Economic Science.” *American Journal of Agricultural Economics* 65 (1983): 548-552.

Washington, A.A. and R.L. Kilmer. “The Derived Demand for Imported Cheese in Hong Kong.” *International Food and Agribusiness Management Review* 5 (2002a): 75-86.

Washington, A.A. and R.L. Kilmer. “The Production Theory Approach to Import Demand Analysis: A Comparison of the Rotterdam Model and the Differential Production Approach.” *Journal of Agricultural and Applied Economics* 34 (2002b): 431-443.

Table 1. The Mean of EU Imported Quantities and Values for Shelled Peanuts from Argentina (AR), China (CN), U.S., and Rest of the World (RS) and U.S. FMD Expenditure.

Variables	Mean	Std Dev	Minimum	Maximum
Quantity for AR shelled peanuts (100 kg)	298645	135060	38769	643808
Quantity for CN shelled peanuts (100 kg)	282718	105333	93549	549702
Quantity for US shelled peanuts (100 kg)	263228	110352	71396	595136
Quantity for RS shelled peanuts (100 kg)	167198	85999	25955	507913
Value of AR shelled peanuts (Euro dollars)	22034343	9885678	2526450	41900359
Value of CN shelled peanuts (Euro dollars)	20111691	7859970	7084498	46298800
Value of US shelled peanuts (Euro dollars)	21732635	7633827	7882526	36259150
Value of RS shelled peanuts (Euro dollars)	11166544	5588292	1765500	30969937
U.S. FMD expenditure (Euro dollars)	71637	14385	50364	113599

Source: EUROSTAT database and American Peanut Council (APC).

Table 2. Parameter Estimates of the Restricted Conditional Differentiated Factor Demand for EU Imports of Shelled Peanuts (Homogeneity and Symmetry Imposed)

Parameter	Argentina	China	United States
Price Coefficients (θ_{ij})			
Argentina	-0.6124** (0.1456)		
China	0.3536** (0.1189)	-0.5954** (0.1560)	
United States	0.0716 (0.1217)	0.3466* (0.1208)	-0.5275** (0.1716)
Rest of the World	0.1871** (0.0636)	-0.1049* (0.0592)	0.1093 (0.0733)
Energy Price Index	0.3542 0.5827	0.0748 0.5036	-0.3764 0.6658
Labor Price Index	2.3630 (1.7616)	-6.4109** (1.5164)	4.7905** (1.9878)
Seasonal Dummy (D_v)			
Quarter1 (January-March)	-0.0895** (0.0243)	0.1105** (0.0209)	-0.0585** (0.0274)
Quarter2 (April-June)	-0.1031** (0.0237)	0.1005** (0.0206)	0.0131 (0.0267)
Quarter3 (July-September)	0.1386** (0.0254)	0.0019 (0.0221)	-0.1208** (0.0287)
Dummy variable			
Farm Bill 2002			-0.0145 (0.0159)
Marginal Factor Shares (θ_i)	0.1439* (0.0814)	0.3094** (0.0702)	0.4374** (0.0920)
Export Promotion (μ_{us}) (U.S. FMD expenditure)	-0.3389** (0.1289)	-0.0242 (0.1114)	0.2699* (0.1451)
R^2	0.8127	0.5966	0.6200
adj-R^2	0.7827	0.5321	0.5502

Significance levels of 0.05 and 0.10 are indicated by ** and *, respectively.
Values in the parentheses represent the standard errors.

Table 3. Conditional Divisia and Price Elasticities of the Restricted Conditional Differentiated Factor Demand for EU Imports of Shelled Peanuts

Exporting Country	Divisia Index	Conditional Own-Price Elasticities	Conditional Cross-Price Elasticities				Elasticities of Export Promotion
			Argentina	China	United States	Rest of the World	
Argentina	0.4951* (0.2539)	-2.1066** (0.6536)		1.2166* (0.5208)	0.2463 (0.5239)	0.6438** (0.2642)	-1.1658** (0.3578)
China	1.1537** (0.2200)	-2.2203** (0.7275)	1.3187** (0.5646)		1.2927** (0.5433)	-0.3911 (0.2610)	-0.0902 (0.3166)
United States	1.4791** (0.2587)	-1.7840** (0.6814)	0.2421 (0.5151)	1.1723** (0.4927)		0.3695 (0.2777)	0.9127** (0.3646)
Rest of the World	0.7518	-1.3166	1.2864	-0.7209	0.7511		0.6406

Significance levels of 0.05 and 0.10 are indicated by ** and *, respectively.
Values in the parentheses represent the standard errors.