# The Export Market for Differentiated Processed Agricultural Products:

# The Role of Factor Prices and Fixed Costs


By

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**Abstract**

The theories of monopolistic competition and "love for variety" contend that the differences in firms' prices and market shares arise from product differentiation, which is linked to firms' fixed costs. This paper reviews these theories and their implications for prices and market shares of firms from developing countries seeking to expand their exports of processed agricultural goods. The study proposes a model showing the role of the firms' costs as a source of product differentiation. Using econometric methods, the model estimates the firms' residual demand elasticities, which indicate the degree of product differentiation and market power. The model also determines the effects of the firms' own costs and competitors' costs on the residual demand and market shares. Case studies for cocoa products and roasted coffee in the U.S. import market are examined. Exporters to the U.S. include developing countries that produce the raw cocoa and coffee. The results show that high prices and large market shares are associated with high levels of product differentiation in these markets. Also, market shares increase with the level of fixed costs, which are measured by proxy as advertising expenditures. The implication for small firms in developing countries is that increasing the degree of product differentiation through increased investment in advertising or research and development could increase their market shares and their export revenues.

*Key words*: fixed costs, industrial organization, international trade, product differentiation

**The Export Market for Differentiated Processed Agricultural Products:**

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## 1. Introduction

For a small country exporter of raw agricultural products, moving towards exports of processed agricultural products is an important step for capturing more value-added output and offsetting the losses from the declining prices of the raw agricultural products in the world market. High-income countries are the major producers and consumers of processed agricultural commodities. Exports of processed agricultural goods to developed countries are limited because of variety of factors, including non-tariff trade barriers, technology barriers, and structural barriers. Interestingly, even in the narrowly defined processed agricultural product categories, the market shares and prices for apparently the same product (such as roasted coffee and cocoa products) vary widely by export sources.[2] The usual explanations of these differences include transportation costs, preferential trade agreements, and sanitary issues. These explanations, however, mask the importance of the level of product differentiation based on the characteristics of the products and services.[3] In fact, processed products are far from being homogenous because of various factors such as the quality of inputs, packaging, and various marketing services.

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[1] Many differences in product contents are not taken into account in commodity classification.

[2] See Table A1 and Table A2 in Appendix A.

Product differentiation leading to differences in prices and market shares are explained by theories of monopolistic competition (Chamberlin) and "love for variety" (Dixit and Stiglitz). These theories suggest that if a firm produces a product that is distinct from others of the same type and if consumers are better off with added varieties, this creates market power and allows the firm to set its price that will determine its market share. These theories imply that the high level of product differentiation originates from the firms' level of fixed costs. The monopolistic competition and love for variety link product differentiation and consumer preference to prices and market shares.

The general objective of this paper is to develop a model to evaluate the effects of a firm's (own and cross) fixed costs on prices and market shares for a differentiated product. The model employs analytic derivations of the firm's residual demand, and of the market shares, using a conjectural variation model. The specific objectives are to determine the elasticity of the firm's residual demand representing the level of product differentiation and firm's market power, and to determine the impacts of fixed and variable costs on residual demands and market shares. The model focuses on the U.S. import markets of cocoa powder and roasted coffee for which the import prices and shares differ among supply sources.

## 2. Theory Overview

The theories of monopolistic competition (Chamberlin, Dixit and Stiglitz) contend that if a firm produces a differentiated product and if consumers are better off with more varieties in the market, then such a firm will have market power. It is also argued that the determinants of production of a differentiated product are the firms' variable and fixed costs (Spence, 1976, 1979; Spencer and Brander; Rosenberg ; Scherer; Baker and Bresnahan; Goldberg and Knetter). Spence (1976) showed that fixed costs play an important role in defining market power and market structure.  This is because the zero-profit condition in equilibrium under the monopolistic competition model, requires that price be equal to average cost.  In the case where the firm has significant fixed costs, price has to be above marginal costs (and therefore above the competitive price) in order for the firm to produce any output.  Fixed costs also limit the number of varieties of a product: only firms that can cover all variable and fixed costs can stay in the industry to produce differentiated products.  Moreover, economic theories of industrial organization predict that the residual demand facing a firm and its market share depend on the input costs of the firm's competitors, as these costs affect the total industry supply.  This means that the competitors input costs do not influence the slope of the residual demand facing the firm, but instead shift the residual demand and affect the firm's market share.

## 3.  Model

This section presents a model that allows estimation of the elasticity of the residual demand facing an individual firm *j* and estimation of the impacts of own and cross-factor prices and fixed costs on the demand and market share (revenue share) of the firm *j*.  A market for several varieties of a product *y* is considered in a country M where consumers have Dixit-Stiglitz type of preferences.  Two different groups of firms in *M* and *N* supply the product *y* to the market. The group *M* consists of symmetric home firms *i* (*i =1, 2, …, m)* located in the country M, while the group *N* consists of different firms *j (j =1, 2, …, n)* exporting to the country M.  Each firm *i* in *M* or firm *j* in *N* produces only a single variety of *y*, and each variety is produced by only a single firm.  In this paper, the same notation is used to indicate a firm and the variety produced by the firm.  Therefore, there are *m+n,* differentiated products (or varieties of product) in the model.

***Demand for Differentiated Products***

This paper assumes that consumers have the Dixit-Stiglitz type of preference in which utility increases with the number of the varieties that monopolistically competitive firms produce. The utility of a representative consumer in M is a function of the amount consumed of different varieties of good $y$ from $m+n$ sources and the amount consumed on all other goods, $q_0$. Using the constant elasticity of substitution specification (Spence, 1976; Dixit and Stiglitz), the consumer utility function is:

$$U = U\left( q_0, \left\{ \sum_i^m y_i^\rho + \sum_j^n y_j^\rho \right\}^{1/\rho} \right)$$

where $y$ is the amount of good (from now on, we also refer to $y$ as the quantity of good $y$) and the subscript on $y$ indicates the variety or the firm producing the variety. The parameter $\rho$ measures the degree of substitution between each pair of differentiated products; $\rho$ is assumed to be $0 < \rho < 1$. A value of $\rho$ close to 1 means that the varieties are almost perfect substitutes.

A consumer spends his total income $I$, where $I = q_0 + \Sigma p_i y_i + \Sigma p_j y_j$, in a two-stage budgeting process. First, income is allocated between all goods, $y$ and good $q_0$ (all other goods), then the amount spent on good $y$ is split among the $m+n$ different varieties. After rearranging terms of the first order conditions of the utility maximization problem subject to the budget constraint, the demand for a single variety of product $j$ is:

(1a) $$y_j = I_y \frac{p_j^{1/(\rho-1)}}{\sum_{i=1}^m p_i^{\rho/(\rho-1)} + \sum_{j=1}^n p_j^{\rho/(\rho-1)}}, \text{ for } j = 1, 2, 3, \ldots, n,$$

where $I_y = \Sigma p_i y_i + \Sigma p_j y_j$ is the income spent on good $y$. Equation (1a) shows that demand for $y_j$ is a function of all prices and income and is homogenous of degree zero in all prices.

The equation (1a) can also be rewritten, for any firm $l$, to express $l$'s output price $p_l$ as a function of firm $l$'s own output, output prices for all the other firms, and consumer's expenditure on variety $l$:

(1b) $$p_l = D_l\,(y_l, p_1, p_2, p_3, \ \ldots \ p_{m+n-1}, I_y),$$

where $D_j\,(\cdot)$ is the inverse demand function.

***Supply of Differentiated Products***

This study assumes that the cost function for any individual firm in $M$ or $N$ can be separated into the cost of raw material and the cost of processing activity. The cost of processing is assumed to be a function of output and the prices of labor and capital. The profit function for any firm $l$ in group $M$ or $N$ is written as:

$$\pi_l = (p_l - \varpi k)y_l - c_l$$

where $k$ is the amount of raw material to produce one unit of the processed good $y$, $\varpi$ is the price of the raw material, and $c$ is the cost function for the processing operation (note that fixed and variable cost are not separated yet).

It is assumed that the raw material market or firms $M$ (the home firms) are oligopsonists and firms $N$ (foreign firms) are price takers. As in Stiegert, Azzam, and Brorsen, the supply of raw material facing a firm $i$ in $M$ can be specified as $\varpi = \psi(ky_i)^{\lambda}$, where the parameter $\lambda$ (which is nonnegative) is the inverse of the price elasticity of supply, an indicator of the oligopsony power ($\lambda$ = 0 under perfect competition). The parameter $\psi$ is a constant (supply shifter). After substituting the expression of the inverse demand function in (1b) and that of the supply of raw material into the profit equation, the first order condition for profit maximization for a firm $i$ in $M$ is written as:

(2) $$p_i - (1+\lambda)k\varpi + \left(\eta_{ii} + \sum_{i'\neq i}^{m} \eta_{ii'}\varepsilon_{i'i} + \sum_{j=1}^{n} \eta_{ij}\varepsilon_{ji}\right) p_i = c_i^{'}(\boldsymbol{\omega}^i)\text{, for } i = 1, 2, 3, \ldots, m,$$

where ω is the vector of input prices in the processing activity, $\eta_{il} = \partial \ln D_l(\cdot) / \partial \ln y_i$ is the change in price for a firm *l* in response to a change in firm *i*'s output ($\eta_{il}$ can also be called the inverse elasticity of demand of firm *i* with respect to output price of firm *l*) and $\varepsilon_{li} = \partial \ln p_i / \partial \ln D_l(\cdot)$ is the inverse of the firm *l*'s change in output price in response to a change in *i*'s output price.

The expression of the first order condition for profit maximization for a firm *j* in group *N* is analogous to equation (2) except that all *n* firms in *N* are assumed to be price takers when purchasing the raw material. The supply relations can then be written as:

(3) $$p_j - k\varpi + \left(\eta_{ji} + \sum_{i=1}^{m} \eta_{ji}\varepsilon_{ij} + \sum_{j'\neq j}^{n} \eta_{ij'}\varepsilon_{j'j}\right) p_j = c_j^{'}(\boldsymbol{\omega}^j)\text{, for } j = 1, 2, 3, \ldots, n,$$

In equation (2) and (3), the expressions inside the parentheses (henceforth denoted as $\eta_i^R$ and $\eta_j^R$ for later use) are commonly called the inverse of the residual demand elasticities and reflect the level of market power of firms.

***Residual Demand Equation for an Individual Firm***

We derive the residual demand facing an individual firm *j*, by using equations (1b), (2) and (3), and following the steps proposed by Baker and Bresnahan. First, consider a firm *l*, one of *j'* s competitors, and a member of any of the group *M* or *N*. From (1b), the inverse demand for firm *l* can also be written as $p_l = D_l\,(y_l\,, p_j\,, \mathbf{p}^{l'}, I_y)$ where $\mathbf{p}^{l'}$ is a vector of prices for all firms *l'* other than firms *l* and *j* ($l' \neq l$ and $l' \neq j$). Similarly, from (3) the (inverse) supply relation for firm *l* can be written as $p_l = D_l\,(y_l\,, p_j\,, \mathbf{p}^{l'}, \omega^l, \varpi)$. The equilibrium price for firm *l* can be written as:

(4a) $$p_l = D_l^*\,(p_j\,, \mathbf{p}^{l'}, I_y, \omega^l, \varpi)\text{, with } l' \neq j \text{ and } l' \neq l.$$

In (4a), the symbol (*) indicates the equilibrium value.

Second, we solve for the equilibrium prices and quantities for all firms *l'* and replace $\mathbf{p}^{l'}$ in (4a) by the corresponding vector of equilibrium prices. After substitution, the equilibrium price in (4a) for firm *l* can be rewritten as:

$$(4b) \qquad p_l^* = D_l^* (p_j , I_y, \omega^l, \omega^{l'}, \varpi) .$$

Equation (4b) is the general form of the equilibrium price for all remaining firms, the *l'*s.

Third, we replace all prices in the right hand side of (1b) by equilibrium prices as expressed in (4b) to get the inverse demand equation for firm *j*:

$$(5) \qquad p_j = p_j \ (y_j , I_y, \omega^l, \omega^{l'}, \varpi).$$

Equation (5) represents the inverse demand function of the residual demand and is the basis of the empirical estimation of the (inverse) of the residual demand elasticity facing an individual firm *j*.[4]

***Free Entry and Zero-Profit Condition***

To evaluate the impact of fixed costs on the shares and prices for differentiated products by sources, it is assumed that each firm is acting as a monopolist, but is forced to bring its profit to zero; otherwise, positive industry profits will encourage new entry until profits are zero. The zero-profit condition for any firm *l* in *M* or *N* is written as $(p_l - k\varpi)\, y_l - c_l = 0$. In addition, the processing costs for *l* consist of fixed and variable costs and that the variable cost function is

[4] Note that the residual demand is not a function of *j*'s own firm input prices, but is a function of the input prices of all other firms and the cost of the raw material.

linearly homogenous in output: $c_l = (c'_l)y_l + \bar{c}_l$, where the bar on $c$ indicates the fixed processing cost.[5] Therefore, the zero-profit condition for a firm $j$ is:

(6) $$p_l - k\varpi = c_l^{'} + (\bar{c}_l / y_l) .$$

From equation (6) onward, all prices and output levels correspond to their equilibrium values; the asterisks are omitted to avoid burdening the notation. Applying (6) to a firm $i$ in $M$, substituting the processing margin ($p_i$-$k\varpi$) of equation (2) to equation (6), and rearranging terms, the revenue for a firm $i$ in group $M$ is:

(7a) $$p_i y_i = -(1/\eta_i^R)\bar{c}_i + (\lambda_i / \eta_i^R)k\varpi y_i .$$

Recall that $\eta_i^R$ is the inverse of the residual demand elasticity for firm $i$. Equation (7a) shows that, assuming the inverse demand elasticity is negative, the revenue for an individual firm is positively related to its fixed costs. Assuming that the $m$ firms in $M$ are symmetric, the elasticity term in (7a) no longer depends on $i$. Summing both sides of equation (7a) over all $I$, the aggregate revenue for $M$ can be expressed as:

(7b) $$\sum_i^m p_i y_i = -(1/\eta_M^R)\bar{c}_M + (\lambda / \eta_M^R)k\varpi y_M ,$$

where, $y_M = \Sigma_i y_i$ is the total output and $\bar{c}_M$ is the total fixed cost for the group $M$.

Also, since revenue is nonnegative, it must be that

(7c) $$0 \le \lambda \le \frac{\bar{c}_M / p_M y_M}{k\varpi / p_M} .$$

Analogously, applying (6) to a firm $j$ in $N$, substituting the processing margin ($p_j$-$k\varpi$) of (3) to equation (6), and rearranging terms, leads to the following expression of the revenue of the firm $j$ in $N$:

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[5] Baumol, Panzar, and Willig pointed out the distinction between fixed and sunk costs. They argued that fixed costs, unlike sunk costs, may still exist in the long run. With such an argument, we can avoid the debate on long-run vs. short-run cost functions in this study.

(8) $$p_j y_j = -(1/\eta_j^R)\bar{c}_j\,,\ \textit{for } j = 1, 2, 3, \ldots, n.$$

In (8), $\eta_j^R$ is the inverse of the residual demand elasticity for firm *j*. Equation (8) shows that if we assume that the inverse of the elasticity of residual demand is always negative, the revenue share for firm *j* (*j*'s export revenue) is directly related to its fixed costs.

***Market Share of an Individual Firm and Fixed Costs***

To examine the impact of fixed costs on the revenue of a particular firm *j* relative to the share of the competing group of firms *M,* (8) is divided by (7b), to derive the ratio of firm *j'*s revenue to group *M*'s revenue

(9a) $$s_{j,M} = \frac{p_j y_j}{\sum_{i=1}^{m} p_i y_i} = \frac{-(1/\eta_j^R)\bar{c}_j}{-(1/\eta_M^R)\bar{c}_M + (\lambda/\eta_M^R)k\varpi y_M}\,.$$

Equation (9a) shows that the size of the revenue for an individual firm *j* relative to the group *M*'s revenue increases with firm *j*'s own fixed costs (provided that price elasticities of demand are negative), but decreases with group *M*'s fixed costs. Furthermore, dividing the denominator of (9a) by $\bar{c}_M$ , the revenue share becomes:

(9b) $$s_{j,M} = \frac{-(1/\eta_j^R)(\bar{c}_j/\bar{c}_M)}{-(1/\eta_M^R) + (\lambda/\eta_M^R)(k\varpi y_M/\bar{c}_M)}\,.$$

Equation (9b) shows that the relative size of the revenue share of an individual firm *j* increases with its fixed costs relative to the fixed costs of competitors in *M,* but decreases with the ratio of *M*'s purchase of raw material $k\varpi y_M$ to *M*'s fixed costs if firms in *M* have oligopsony power.[6]

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[6] This derivation is more straightforward than the approaches taken by Shaked and Sutton, and Röller and Sickles, which employ multi-stage games to determine the outcomes of the capacity (fixed costs) competition among firms.

## 4. Empirical and Econometric Models

For any individual firm *j* in *N*, we used the system of equations in (3), (5), and (9b). A double log form of the residual demand in (5) is employed so that the estimated coefficient on quantity will represent the inverse of price elasticity of demand. Similarly, the relative share in (9b) will be expressed in double log form. We used a linear Diewert cost function (derived from the generalized Leontief profit function) of the form $c_j = y_j \sum_f \sum_{f'} b_{ff'} \sqrt{\omega_f \omega_{f'}}$, where *f* and *f'* are the labor, and capital inputs, in order to derive the marginal cost for the supply equation in (3). Finally, the following equations form the system of equations to be estimated econometrically for a firm *j*:

(10) (residual demand) $$\log p_{jt} = \alpha_{j0} + \eta_j^R \log y_{jt} + \sum_{j' \neq j}^{n} \sum_{f}^{2} \delta_{jj'f} \log \omega_{ft}^{j'} + \mu_j \log I_{yt} + u_{jt},$$

(11) (supply relation) $$p_{jt} = \beta_{j0} + \beta_{j1}(k\varpi) + \sum_{f=1}^{2} \sum_{f'=1}^{2} \beta_{jff'} \sqrt{\omega_{ft}^{j} \omega_{f't}^{j}} + u_{jt}^{'}$$

(12a) (relative share) $$\log s_{j,Mt} = \gamma_{j0} + \gamma_{j1} \log(\bar{c}_{jt} / \bar{c}_{Mt}) - \log(1 - \lambda k \varpi y_M / \bar{c}_{Mt}) + u_{jt}^{''},$$ with

(12b) $$\gamma_{j1} = \frac{\eta_M^R}{\eta_j^R} > 0.$$

Equation (10) and (12a) are the double log form for the residual demand in (5) and relative share in (9b). Equation (11) includes the feature of Diewert marginal cost. The stochastic term *u* is added in each equation, assuming that there are some errors when individual firms and consumers make their decisions. The $\omega$'s are firms' factor prices and *t* is the time period. The parameters to be estimated are $\eta$ (expected to be negative), the *δ's,* the *μ's,* the *β's,* and the *γ's*.

***Issues in Empirical Implementation***

The main difficulty in implementing the above model was the lack of data representing fixed costs. We used advertising expenditure -- the only available data -- as a proxy for the fixed cost for the U.S. firms.[7] Advertising expenditure was cited as a "capacity input" in Sutton, and Röller and Sickles, and used as a source of product differentiation or sunk costs in Comanor and Wilson (1969) and Shepherd.[8] Yet, the actual level of advertising by each firm in *N* is not available, but can be assumed to be a fraction ($\alpha_t$) of its export revenue or:

(13a) $$\bar{c}_{jt} = \alpha_{jt}(p_{jt} y_{jt}), \text{ and}$$

(13b) $$\bar{c}_{Mt} = \alpha_{Mt}(p_{Mt} y_{Nt}).$$

These $\alpha$*'s* are commonly referred to as the advertising-to-sale ratios. Substituting (13a) and (13b) into (12) yields the following:

(14) $$\log s_{jMt} = \gamma_{j0} + \gamma_{j1}\left(\log \alpha_{jt} - \log \alpha_{Mt} + \log s_{jMt}\right) - \log\left[1 - \lambda \frac{k\varpi_t}{p_{Mt}} . \frac{1}{\alpha_{Mt}}\right] + u_t^{''}.$$

The second log term in (14) still poses some difficulties for estimation because we do not have prior knowledge of $\lambda$, the parameter measuring the degree of oligopsony power in the market for the raw product. Because our focus is not on estimating $\lambda$, we adopt an equivalent formulation based on the observations that the third log term in the right hand side of (14) vanishes when $\lambda$ =0 (a perfect competition model of the market for raw material) and that the term inside the log is nonnegative (see restriction in (7c)). We can write the following:

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[7] The U.S. Manufacturing Census data do not regularly provide a detailed list of all fixed costs. Also, separating fixed cost from variable costs was not feasible even for the years where the Census released relatively more detailed data.

[8] Thorough analyses of the role of advertising on competition and as barriers to entry are presented in Comanor and Wilson (1967, 1971, and 1979); Dixit and Norman; Ayanian; Matraves; and Morton.

$$-\log\left[1-\lambda\frac{k\varpi_t}{p_{Mt}}\frac{1}{\alpha_{Mt}}\right]\approx\phi(\lambda)\log(k\varpi_t/p_{Mt})+\phi^{'}(\lambda)\log(\alpha_M),$$

for which $\lambda=0$ implies that $\phi(\lambda)=\phi'(\lambda)=0$. The $\phi(.)$'s are arbitrary functions.

Thus, the equation of the relative share for estimation purposes becomes:

(15) $$\log s_{jMt}=\frac{\gamma_{j0}}{(1-\gamma_{j1})}+\frac{\gamma_{j1}}{(1-\gamma_{j1})}\log\alpha_{jt}+\frac{\phi^{'}(\lambda)-\gamma_{j1}}{(1-\gamma_{j1})}\log\alpha_{Mt}+\frac{\phi(\lambda)}{(1-\gamma_{j1})}\log(k\varpi_t/p_{Mt})+u_t^{''}.$$

In (15), the relative share depends on the advertising-to-sale ratios of the firm *j* and its competitors in *M*.[9] The relative share also depends on $k\varpi/p$, which is the ratio of the cost of raw material to produce one unit of final good to the final good's unit price. The ratio $k\varpi/p$ is indicative of the processing margin and profitability in *M;* the smaller is the ratio, the higher the processing margin. However, the effects of the processing margin mainly depend on $\phi(\lambda)$, that is, on whether firms in M have are oligopsonists in the market for raw material.

## 5. Estimation and Results

The commodities examined are two products: (i) cocoa powder and cocoa cake (part of SIC 2066); and (ii) roasted coffee (SIC 2095). Developing countries, along with some developed countries, process the raw material and export the processed product to the U.S. market. However, the supplies to the United States for these commodities are highly concentrated in a few U.S. firms, leaving only small shares of the market to firms from other countries. In this

[9] The parameter $\gamma_{j1}$ is nonnegative, and whether $\gamma_{j1}$ is greater or less than one will determine the sign of coefficient on the log of the ratio of advertising to sale ratios in (15). According to (12b) $\gamma_{j1}$ is less than one when $\eta_j^R > \eta_M^R$, that is, when the demand curve facing *j* is steeper (i.e. less elastic) than that facing *M*. The increase in the level of *j*'s fixed costs to revenue ration (advertising-sale ratio) will increase its market share of *j* relative to firm *M* if j's product is highly differentiated. Moreover, the impact of *M*'s fixed costs to revenue (advertising to sale) ratio on *j's* relative market share does not depend solely on $\gamma_{j1}$ and the residual demand elasticities; it depends also on $\phi(\lambda)$, which contains information on the structure of the market for raw material.

study, the U.S. firms are taken as the member of the group *M* (home firms). The exporting countries are treated as one group *N* because data at the firm level are not available; the limited export volume of the developing countries also justifies the approximation. Further explanation on the data is presented in Appendix A.

Econometric methods are employed to estimate equations (10), (11), and (15).[10] The total U.S. advertising expenditure is the variable shifting the residual demand alongside U.S. income in estimating (10). In addition, because information is not available for advertising-to-sales ratios for the individual firms $\alpha_{jt}$, the second term on the right hand side of equation (15) is represented by a dummy time-trend variable. For each country, equations (10), (11), and (15) are estimated by OLS and SUR procedures, and the results are compared. The SUR estimates are often superior to OLS, except for The Netherlands.[11] Results are summarized in Table 1 and Table 2 where the variable names are written more explicitly.

***Cocoa Powder***

Table 1 summarizes the results for all countries. The elasticities of the (inverse) residual demand for all exporting countries are negative, and statistically significant for Canada and The Netherlands, a consequence of their differentiated products. The Netherlands has the highest estimate of the elasticity, which is consistent with the relatively high unit prices and high market shares of the country. On the other hand, Canada appears to have a limited

[10] The parameter estimates for equation (11) are not reported as they are not relevant for the interpretation.

[11] Strickland and Weiss indicated the usefulness of considering the kind of equations in this model that involve level of advertising as part of a system of equation, and if data permit, as simultaneous equations.

market power, as indicated by the low price elasticity. Brazil and Côte d'Ivoire face competitive demand curves and have no market power, which is consistent with their relatively low import shares in the U.S. market.

The results also show that the residual demand facing The Netherlands increases with increases in competitors' costs, which are due to wages in Canada and the interest rate in the United States. Similarly, the demand for Brazil increases (an upward shift of demand) when there is a rise in wages or interest rates in Canada. Geography and trade closeness of Brazil and Canada to the United States are perhaps part of the explanation.

An increase in the U.S. per capita income affects only the demand for cocoa powder from The Netherlands, a confirmation of the preference by the U.S. consumers for Netherlands' cocoa powder. In addition, an increase in U.S. advertising has negative and significant effects only on cocoa powder demanded from Brazil, implying that its products are most vulnerable in competing with U.S. made products and that they are not sufficiently differentiated.

The U.S. advertising-to-sales ratio has positive effects on the market share of all countries, except Côte d'Ivoire. The time trend to represent the shift in the ratio of fixed cost relative to revenue has been increasing over time, except for Brazil. This indicates that, in general, a rise in the advertising-to-sale ratio of a foreign exporter increases the exporter's market share relative to that of the U.S. firms.

***Roasted Coffee***

The results for roasted coffee are summarized in Table 2. All the exporting countries except Colombia have statistically significant residual demand elasticities, which are indicative of product differentiation and market power. Moreover, the elasticities are higher for The Netherlands, Sweden, and Canada than for any other countries, indicating that coffee roasters from these three countries have relatively high degree of market power. The roasted coffee from Colombia has little market distinction in the U.S. market, but this is not surprising since most consumers know the Colombian variety and the U.S. firms import mainly green Colombian coffee. This suggests that even a known variety of the raw material is not enough to bring about product differentiation for the processed product in the market. Other factors, such as quality of the delivery services and presentation of the products, could be influential factors for product distinction.

The results in Table 2 also indicate that demand for Mexican and Brazilian coffee increases (upward shift) in response to any increase in U.S. consumer income, indicating a preference for the roasted coffee from these two countries. Unlike the case of cocoa powder, there are more significant cross-input cost effects among competitors. In fact, the demand facing Brazilian coffee roasters increases as the average industry wage in Mexico and the wage and interest rate in Sweden increase. Similarly, the rise in wage rate in the coffee roasting industry in the United States shifts the demand for roasted coffee from The Netherlands and Sweden.

The U.S. advertising expenditure in the coffee industry has mixed impacts on the six countries' export demand. It causes an increase in the residual demand for coffee roasted from Sweden, but reduces that from Brazil. The explanation is that advertising shifts overall market demand upward and induces an increase in the export demand. Sweden, a relatively large exporting country, benefits from this increase because most of its processors use green "Colombian" coffee, which is one of the varieties widely used by U.S. processors. The positive impact of advertising is consistent with the idea that advertising has a positive externality on firms that do not pay for it, for example, by creating name recognition. The U.S. advertising, however, shifts consumers' preference away from Brazilian roasted coffee, which is mostly derived from a different variety, "Brazilian Arabica." The study finds no significant effects of U.S. level of advertising on the demand for roasted coffee from Canada, Colombia, and Mexico.

The impacts of U.S. advertising-to-sales ratio are statistically significant and positive for Mexico, The Netherlands, and Sweden. An increase in the intensity of advertising by U.S firms seems to benefit the exporters from these three countries. As before, a reason is that firms in these countries mostly roast for export the varieties that are widely roasted in the United States, "Colombian" and "Non-Brazilian Arabica."

The coefficients on the time trend dummy are positive and significant, except for Sweden, indicating that the relative shares are mostly increasing over time and that may be associated with the increase in the advertising-to-sales ratios. However, other factors such as reduced trade barriers could also explain the coefficient associated with this time trend.

For both the cocoa powder and roasted coffee models, the coefficients on the ratio of cost of raw materials to the price of processed goods, are statistically significant, especially for countries where the U.S. firms import the raw materials, mainly Brazil, Côte d'Ivoire and Colombia. This indicates that U.S. firms, among the largest importers and processors of coffee and cocoa, may have some oligopsony power in the raw material markets. However, the sign of the coefficient on the same ratio varies across countries. The positive and statistically significant coefficients on the ratio for Brazil (for coffee) and Côte d'Ivoire (for cocoa) suggest that the widening of the U.S. processing margin (a decrease in the ratio) will reduce the market shares of these countries compared to the market shares for U.S. firms. On the contrary, the negative sign for Columbia (for coffee) and Brazil (for cocoa) indicates that widening of the U.S. processing margin will actually benefit these countries' market shares. There seems to be no consistent explanation of the direction of the impacts of the processing margin on market shares; further research is needed.

## 6. Conclusions

This paper attempts to explain why in a tight import market some exporters have relatively high export prices and large market shares than do others. The paper proposes a model that can be used to test the implications in trade of theories that argue that the differences in prices and market shares arise from product differentiation and fixed costs. The approach is to measure, in terms of elasticities, the level of product differentiation and degree of market power among competing firms on the one hand, and the effects of the firm's own and cross costs on prices and market shares on the other hand. In particular, the level of product differentiation of a firm's product variety is measured as the elasticity of the inverse of the residual demand that it faces; such elasticity also indicates the firm's degree of market power. The zero-profit condition in a monopolistic competition model is assumed in order to estimate the impacts of firm's fixed costs on markets share. Case studies for processed cocoa and coffee exported to the United States are examined. The exporters include developing countries that produce the raw materials used in the processing activities and seek to expand their export revenue by processing these raw materials.

The results confirm the hypothesis that high prices and large market shares are associated with high levels of product differentiation and market share. Despite the limited access to the U.S. market, the high levels of differentiation of cocoa powder from The Netherlands and of roasted coffee from Canada and Sweden provide exporters in these countries with relatively high market shares and export prices. In contrast, firms exporting cocoa powder and roasted coffee from large producers of the raw materials, such as Côte d'Ivoire (for cocoa) and Colombia (for coffee), lack market power as their products have low levels of differentiation; their prices and market shares are relatively low. In addition, changes in an exporter's input prices affect the residual demand facing its competitors, which implies that firms or countries with easier access to key inputs (namely, skilled labor and capital for investment) may increase their ability to differentiate their products and at the same time depress the demand and market shares of other competitors.

Using the available information on advertising expenditures to represent fixed costs, this study finds that the impacts of U.S. advertising expenditure on demand and market share of various exporters are mixed. Exporting countries that use the same raw material that is processed in the United States only appear to benefit from the advertising paid by U.S. firms. The results also show that the firms' market shares increase with their fixed cost to sale ratios. The implication is that the export revenues of firms in small exporting countries like Colombia and Côte d'Ivoire can be expanded by increasing the level of differentiation of their products through investment, which entails fixed costs such as advertising, product distribution, and research and development.

## Appendix A: Data and Data Sources

### *Cocoa Powder (or Cocoa Cake)*

The cocoa processing industry (SIC 2066) has one of the highest concentration ratios in the U.S. food industries (4 firms produced 75 percent of the industry value of shipments in 1992). For cocoa powder, the sources of U.S. imports during 1999 that are included in the analysis with their respective volume shares are: The Netherlands (67 percent of total import value), Brazil (4 percent), Canada (3 percent), and Côte d'Ivoire (3 percent). Imports of cocoa powder represent 30 percent of the total U.S. demand; the rest (70 percent) is produced locally.

Table A1 shows quarterly average of export prices (custom values) and market shares and prices of countries exporting to the United States during the period 1995-99. The Netherlands was the major import source for the United States and also received the highest prices.

**Table A1. Exports of Cocoa Powder to the U.S. (1995:I-1999:IV)**

| **Exporting Country** | **Share** (%) | **Unit Value** ($/kilogram) |
|---|---|---|
| Brazil | **4.44** | **0.78** |
| | (1.74) | (0.05) |
| Canada | **1.75** | **1.19** |
| | (1.61) | (0.21) |
| Côte d'Ivoire | **2.67** | **0.56** |
| | (1.68) | (0.14) |
| The Netherlands | **71.91** | **1.27** |
| | (4.56) | (0.11) |
| Other | **19.23** | |

Source: U.S. Department of Agriculture
Note: Figures in parentheses are standard deviations

### *Roasted Coffee*

The U.S. coffee roasting industry also is a concentrated -- the top 4 firms produced 66 percent of the industry value of shipments in 1992, according to the Census Bureau. Roasted coffee imports are very limited and represent only 7 percent of the U.S. total demand. Between

1995 and 1999, the major sources of U.S. imports of roasted coffee are shown in Table A2. Although Canada and Brazil were the leading exporters to the U.S. during 1995-99, the price of roasted coffee from The Netherlands is the highest.

**Table A2. Exports of Roasted Coffee to the U.S. (1995:I-1999:IV)**

| **Exporting Country** | **Share** (%) | **Unit Value** ($/kilogram) |
|---|---|---|
| Brazil | **17.12** | **6.12** |
| | (7.17) | (1.32) |
| Canada | **27.50** | **6.62** |
| | (8.98) | (1.44) |
| Colombia | **6.30** | **6.83** |
| | (3.03) | (1.04) |
| Mexico | **9.72** | **6.66** |
| | (2.52) | (0.84) |
| The Netherlands | **6.57** | **9.27** |
| | (0.81) | (1.05) |
| Sweden | **11.35** | **6.11** |
| | (5.64) | (0.83) |
| Other | **21.44** | |

Source: U.S. Department of Agriculture
Note: Figures in parentheses are standard deviations

### *Data Sources*

For the U.S., the volume, value, and unit price of the domestic production of processed products are from the Census Bureau and the Bureau of Labor Statistics of the U.S. Department of Commerce. U.S. imports data by source were from Data Access Retrieval and Tabling System (DARTS) used by the U.S. Department of Agriculture/ Economic Research Service (USDA/ERS). Prices of the manufactured product from abroad are the c.i.f. unit values. Prices of the raw material are taken from the commodity prices published by the International Monetary Fund (IMF). The advertising data for the U.S. cocoa and coffee industries come from the IMF and the USDA/ERS. Interest rates are real interest rates calculated from nominal market interest rate from IMF publication.

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**Table 1. Parameter Estimates of the Residual Demand and the Impact of Advertising on Market Share for Differentiated Cocoa Powder Exported to the United States**

| Equation | Brazil | Canada | Côte d'Ivoire | The Netherlands |
|---|---|---|---|---|
| **Residual demand** (dep. Var : lnP) | | | | |
| LnY | -0.003 | -0.124*** | 0.041 | -0.510** |
| | (-0.140) | (-3.200) | (1.260) | (-2.870) |
| Ln(WH_bra) | | 2.800 | | |
| | | (1.540) | | |
| LnWH_can | 2.603*** | | | 1.015*** |
| | (4.710) | | | (2.940) |
| LnWH_cot | | | | |
| LnWH_net | | 0.967 | | |
| | | (1.360) | | |
| LnWH_us | | | 1.279 | -0.289 |
| | | | (1.010) | (-1.06) |
| LnWK_bra | | | | |
| LnWK_can | 0.187 | | | |
| | (1.98) | | | |
| LnWK_net | | | | |
| LnWK_us | -0.154 | 1.152 | -0.437 | 0.783** |
| | (-0.510) | (1.460) | -0.580 | (2.770) |
| LnINCOME | -0.064 | 0.029 | -0.040 | 0.593** |
| | (-0.910) | (0.16) | (-0.180) | (2.720) |
| LnAD | -0.248*** | 0.148 | -0.222 | 0.052 |
| | (-4.950) | (1.000) | (-1.59) | (0.910) |
| **Share** (dep var.:lnSHARE) | | | | |
| TIME | -0.004 | 0.083** | 0.158*** | 0.030* |
| | (-0.220) | (2.320) | (3.690) | (1.870) |
| LnADTSALE | 1.316*** | 1.120* | -1.175 | 1.175*** |
| | (3.960) | (2.090) | (-1.370) | (0.200) |
| Ln(RAWCOST/Pu) | -1.296** | -0.318 | 3.806** | -0.579 |
| | (-2.150) | (1.250) | (2.450) | (-1.180) |
| R-Square | 0.75 | 0.84 | 0.75 | 0.81 |
| Method: | SUR | SUR | SUR | SUR |

Note: The prefix " *ln*" represents natural log, P is the export price; Y is the export volume; WH is the wage in cocoa industry; WK is the country's interest rate; INCOME is GDP (U.S.), AD is the level of U.S. advertising expenditures; SHARE is the ratio of the export value to U.S. firms value of shipments; TIME is the time trend; ADTSALE is the U.S. advertising-to-sale ratio; RAWCOST is the cost of green coffee to make one unit of roasted coffee; and Pu is the U.S price of cocoa powder. The country denominations are bra=Brazil, can=Canada, cot=Côte d'Ivoire, net= The Netherlands, and us=United States. The *, **, and *** are significance levels at 0.1, 0.05. and 0.01 respectively. Figures in parentheses are t-values.

**Table 2. Parameter Estimates of the Residual Demand and the Impact of Advertising on Market Share for Differentiated Roasted Coffee Exported to the United States**

| Equation | Brazil | Canada | Colombia | Mexico | The Netherlands | Sweden |
|---|---|---|---|---|---|---|
| **Residual demand** | | | | | | |
| (dep. Var : lnP) | | | | | | |
| LnY | -0.174*** | -0.225*** | -0.127 | -0.172* | -0.289** | -0.346*** |
| | (-6.620) | (-3.410) | (-1.300) | (-2.130) | (-3.050) | (-3.280) |
| LnWH_can | -4.026*** | | | | | |
| | (-3.60) | | | | | |
| LnWH_col | | 0.161 | | | -0.111 | |
| | | (1.270) | | | (-0.910) | |
| LnWH_mex | 0.788* | | | | | |
| | (3.560) | | | | | |
| LnWH_net | -0.684** | -0.162 | 0.224* | -0.052 | | |
| | (-3.290) | (-1.180) | (1.790) | (-0.790) | | |
| LnWH_swe | 1.606*** | | | -0.798** | | |
| | (6.380) | | | (-2.690) | | |
| LnWH_us | -.936* | | | | 0.890*** | 2.193** |
| | (-2.250) | | | | (3.030) | (2.650) |
| LnWK_bra | | | | | | 0.236* |
| | | | | | | (2.810) |
| LnWK_can | | | -0.314** | -0.713*** | | |
| | | | (-2.450) | (-3.590) | | |
| LnWK_col | | | | | 0.173** | 0.106 |
| | | | | | (2.510) | (0.900) |
| LnWK_swe | 1.340*** | | | 2.104*** | | |
| | (5.390) | | | (6.190) | | |
| LnWK_us | | 0.307 | | -2.409*** | | |
| | | (0.690) | | (-4.680) | | |
| LnINCOME | 18.117*** | 0.172 | -4.324 | 4.411*** | 0.954 | -1.406 |
| | (5.320) | (0.230) | (-0.570) | (5.720) | (0.400) | (-0.340) |
| LnAD | -0.158** | 0.069 | 0.113 | 0.098 | 0.083 | 0.217** |
| | (-3.470) | (1.100) | (0.990) | (1.130) | (1.690) | (2.730) |
| R-Square: | 0.96 | | | | 0.96 | |
| | | | | | | |
| **Share** | | | | | | |
| (dep var.: SHARE) | | | | | | |
| TIME | -0.071*** | 0.066*** | 0.108*** | 0.055*** | 0.034*** | 0.001 |
| | (-3.470) | (4.62) | (5.050) | (3.710) | (4.170) | (0.140) |
| LnADTSALE | -0.439 | 0.408 | 0.495 | 0.616** | 0.335** | 0.491** |
| | (-1.120) | (1.480) | (1.200) | (2.170) | (2.110) | (2.770) |
| | | | | | | |
| Ln(RAWCOST/Pu) | 1.022** | -0.0178 | -1.067** | -0.333 | -0.269* | -0.308* |
| | (2.770) | (-0.070) | (-2.750) | (-1.250) | (-1.790) | (-1.820) |
| System or Equation | | | | | | |
| R-Square: | 0.43 | 0.95 | 0.79 | 0.82 | 0.62 | 0.84 |
| Method: | OLS | SUR | SUR | SUR | OLS | SUR |

Note: The prefix " ln" represents natural log; P is the export price; Y is the export volume, WH is the wage in roasting coffee industry; WK is the country's interest rate; INCOME is GDP in U.S.; AD is the level of U.S. advertising expenditures; SHARE is the ratio of the export value to U.S. firms value of shipments; TIME is the time trend; ADTSALE is the U.S. advertising-to-sale ratio; RAWCOST is the cost of green coffee to make one unit of roasted coffee; and Pu is the U.S price of cocoa powder. The country denominations are bra=Brazil, can=Canada, col=Columbia, mex=Mexico, net= The Netherlands, swe=Sweden,and us=U.S. The *, **, and *** are significance levels at 0.1, 0.05. and 0.01 respectively. Figures in parentheses are t-values.