Allocation of Global Import Demand for Coffee among the World's Largest Economies: Implications for Developing Countries

Shiferaw T. Feleke and Lurleen M. Walters

Food and Resource Economics Department, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL 32611-0240, Telephone :(352) 392-1881, Emails: **tesfaye@ufl.edu**; **lwalters@ufl.edu**

Abstract

The study implies that coffee producing countries will be worse off with the expansion of exports. Hence, we suggest that they pursue new marketing strategies that involve market segmentation, value-adding activities, and strengthening local and global organizations to establish direct market links with consumers and stabilize prices.

Key words: Coffee, imports, marketing strategies

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Background

Coffee is a truly global commodity and a major foreign exchange earner in many developing countries where over 90% of world coffee production takes place (Ponte, 2002). Brazil, Vietnam, and Colombia are the world's largest producers. In 2002-2003, 60 percent of world supply came from these three producers (Lewin, et al. 2003). Brazil produces hard arabica and robusta while Vietnam and Colombia produce robusta and mild arabica, respectively. Only 25% of the world's coffee is consumed in producing countries, which are mostly developing countries. Most of the consumption takes place in industrialized countries. Almost all global coffee exports are of green coffee, and the United States, European Union, and Japan are the world's largest importers of green coffee. The dominant trade paradigm for the coffee industry is of pricing set according to the New York Coffee, Sugar and Cocoa Exchange and the London International Financial Futures and Options Exchange.

Over the past four decades, the coffee industry has witnessed paradigm shifts in supply and demand (Lewin, et al. 2003). The new development on the supply side is oversupply caused by Vietnam's entry into the world coffee market, adoption of mechanization in Brazil, and the collapse of the International Coffee Agreement, as well as the deregulation of the coffee sector in producing countries.

The major change on the demand-side is stagnant overall growth in the traditional major importing countries. Over the past four decades, per capita consumption in United States has been declining (Figure 1), and Northern European consumption, particularly in Germany, is stagnant. The average per capita consumption of coffee in US declined from

6.7 kg in the 1960s to 4.1 kg in the 1990s (FAO, 2004). Although Japanese and EU consumptions have increased over time, and new markets have emerged in Eastern Europe and Asia, it would seem that the increases in those markets are insufficient to offset the overall slump of demand in the US.

The effect of these changes has been a record low level of prices that has affected the lives of millions of people in developing countries (Figure 2). The International Coffee Organization acknowledges that the coffee industry is facing the worse crisis in history, trapped in a vicious circle of sluggish demand, excess supply, and collapsing prices, thus resulting in growing levels of poverty and unemployment in producing countries (ICO Annual Review, 2002/03). The report warns that if nothing is done to halt the decline, the consequences are likely to be dire for many producing countries.

In order to draw implications about the welfare of producing countries, a system of import demand equations for green coffee is estimated for the world's largest economies. Toward this end, a differential production approach to the theory of the firm is employed, and Divisia volume index and conditional price elasticities are estimated. Based on our findings, we discuss the policy implications, as well as the avenues that can be taken to ameliorate the crisis in developing countries.

Overview of the World Coffee Market

Over the past four decades, the coffee industry has witnessed changes in governance structure and institutional framework, which have greatly influenced international coffee exports and imports (Ronning, 1991; Ponte, 2002). Prior to 1989, coffee trade was governed by the International Coffee Agreement (ICA), which was

signed in 1962. The ICA was effective in the sense that producing and consuming countries generally agreed on pre-determined supply levels that were enforceable via export quotas that kept prices high and stable within a price band of $1.20/lb to $1.40/lb (Oxfam, 2002). Quotas were only relaxed in instances where prices exceeded the band. Governments in producing countries were actively involved in the marketing process, and determined export levels. In July 1989, when the agreement collapsed mainly because members could not agree on ways to control exports to nonmembers and to distribute quotas, world coffee prices fell sharply because of increased exports from accumulated stocks (Akiyama, et al. 2001). The sharp decline of prices was later exacerbated due to Vietnam's entry into the world market as the second largest supplier of coffee, and the implementation of new production methods and mechanization in Brazil, as well the liberalization of the coffee sub-sector in producing countries.

Coincidentally, the collapse of the ICA and weakening of domestic regulatory power stemming from market liberalization in producing countries resulted in a transfer of power to transnational roaster companies[1]. According to Ponte (2002), in 1995 these companies retained nearly 80 percent of total income generated, by way of value-added activities. At the present, producing countries retain far too little value of the coffee market. Further, it is ironic that while companies have improved upon processing technologies, the actual quality of the coffee consumed has deteriorated. The fact that the average consumer is oblivious to this is testament to the sophistication of processing techniques that allow roasters to *"mask the bitterness of the cheaper and lower-quality coffees, so enabling them to use more of them in their blends than they had been previously able to get away with"* (page 28; Oxfam 2002).

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[1] Nestle, Kraft, Procter & Gamble, and Sara Lee.

In the meantime, there have been increased demands for soluble coffee, differentiated and higher-value products, and geographic-generational shifts in the popularity of different types of coffee products (Lewin, et al, 2003). In the US market, specialty coffee consumption is on the rise, much to the detriment of 'regular' coffee consumption. It is not clear how beneficial this niche market will be for producing countries, since the concept is more geared towards selling a particular 'ambiance' or 'consumption experience' to consumers in cafés like Starbucks and Java Hut. The product may or may not be of high quality, but by merely allowing consumers to choose certain attributes of the final product, companies are able to extract higher prices.

Theoretical Framework

The common approaches applied to import demand analysis of most agricultural products involve use of consumer demand theory and production theory. The first one treats imports as final goods that directly enter into consumers' utility function while the second one treats imports as inputs that enter into firms' cost or profit functions. Treating green coffee as an input because of the fact that it goes through some transformations before reaching consumers, we derive input demand functions from a cost minimization problem, and estimate demand elasticities. However, there are no empirical differences in estimates of conditional elasticities between the differential production and differential consumer demand approaches; differences lie in the estimates of unconditional elasticities (Washington and Kilmer, 2002) and the interpretation and constraints implied by economic theory (Goddard and Akiyama, 1989).

The application of production approach to international trade is not a new concept (Burgess, 1974; Kohli, 1978; Diewert and Morrison, 1989; Truett and Truett, 1998; Washington and Kilmer, 2002). Unlike the case with the consumer demand approach, the production approach lends itself to a consistent data aggregation. In other words, the optimal firm behavior of profit maximization can hold at the industry level since the aggregate profit obtained when each firm is maximizing profit, taking prices as given, is the same as that can be obtained if all firms were to make a joint profit maximizing decision (Mas-Colell, Whinston and Green, 1995).

Hence, we set up the cost minimization problem in such a way that each country's coffee importing firms minimize their costs subject to an implicit function of world import production as

(1) $\qquad C = w'x \qquad$ subject to

(2) $\qquad f(y,x) = 0$, where C is total cost of imports; x is quantity of green coffee imported in each country; w is import prices and y is global imports.

The first order conditions of the Lagrangian function will provide a system of import demand functions given as

(3) $\qquad x_i = g(y, w_j)$ where $i = 1, ...,4; j = 1,...,4.$

With total differentiation and a series of substitutions, one can come up with an import allocation model.

Empirical Model

Following Laitinen and Theil (1980), the global import allocation model of green coffee derived from the differential approach to the theory of the firm can be specified as

(1)
$$f_i d(\log x_i) = \alpha_i + \mu_i d(\log Q) + \sum_{i=1}^{4} \pi_{ij} d(\log w_j) + \varepsilon_i$$

where

f_i is the ith country's industry share in the global cost of imports;

$d(\log x_i)$ is the ith country's industry log change in quantity demanded of coffee;

α_i is the ith country's industry intercept

μ_i is the ith country's industry mean share in the global marginal cost of importing coffee;

$d(\log Q)$ is the global Divisia volume input (import) index;

π_{ij} are conditional price coefficients.

Homogeneity and symmetry are tested to check for the compatibility of the empirical estimation with economic theory.

(2)
$$\sum_{i=1}^{4} \mu_i = 1; \qquad \sum_{i=1}^{4} \pi_{ij} = 0 \quad \text{(Adding Up)}$$

(3)
$$\sum_{j=1}^{4} \pi_{ij} = 0 \qquad \text{(Homogeneity)}$$

The homogeneity-constrained version of the model is thus

(4)
$$f_{it} d(\log x_{it}) = \mu_i d(\log Q_t) + \sum_{j=1}^{3} \pi_{ij} (d \log w_{jt} - d \log w_{nt}) + \varepsilon_{it}.$$

The Divisia volume index elasticity (ε_{xQ}) and conditional price elasticities (ε_{xw}) are derived by differentiating equation (4) with respect to the Divisia volume index and prices.

$$(5) \qquad \varepsilon_{xQ} = \frac{d(\log x_i)}{d(\log Q)} = \frac{\mu_i}{f_i}$$

$$(6) \qquad \varepsilon_{xw} = \frac{d(\log x_i)}{d(\log w_j)} = \frac{\pi_{ij}}{f_i}$$

Finally, the property of symmetry $\pi_{ij} = \pi_{ji}$ is imposed on equation (4).

Data and Analytical Methods

Data for this study came from the Agriculture and Trade section of the web page maintained by the Food and Agricultural Organization (FAO, 2004). The annual quantities of coffee (Mt) and value of imports ($ 1000) of green coffee were obtained for 1961 to 2003. The values of imports are on a cost, insurance, and freight (CIF) basis, which include costs of the product, insurance, and transportation. Unit import values ($/kg), which proxy commodity prices, were obtained by dividing import values by import quantities.

The method used to estimate the system of demand equations for coffee is Full Information Maximum Likelihood (FIML) in Time Series Processor program (TSP4.4). This method is based on the entire system of equations, and estimates all parameters jointly. When estimating the system of demand equations, one of the equations was deleted to avoid singularity in the covariance matrix. However, parameter estimates of the deleted equation were recovered by re-estimating the system with another equation in the system. Parameter estimates are invariant to the deleted equation when using maximum likelihood estimation (Barten, 1969). With normally distributed disturbances, the full information maximum likelihood method has all the desirable asymptotical properties of Maximum Likelihood (ML) estimators and, therefore, is asymptotically

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efficient among all estimators (Greene, 2000). The Likelihood Ratio test was used to test autocorrelation, symmetry and homogeneity.

Empirical Results

Table 1 presents the log-likelihood values, the log likelihood ratio (LR) statistics, and the critical values for the LR test for autocorrelation. The likelihood ratio test rejected the null hypothesis of no autocorrelation, implying that the data is serially correlated. Hence, applying the HILU procedure (Hildreth and Lu, 1960), we chose the optimum coefficient of autocorrelation ($\rho = -0.37$) and corrected the problem in question.

The LR tests were also applied to test if the data satisfy the economic properties of homogeneity and symmetry (Table 2). Results indicate that neither homogeneity nor symmetry was rejected. The property of negative semi definiteness was also verified by inspection of the Eigen values of the price coefficient matrix. This property is validated when all of the Eigen values are less than or equal to zero. These results imply that importing firms behave optimally.

Table 3 presents the parameter estimates of the model to which both homogeneity and symmetry were imposed. Intercepts were included to capture possible time trends and serve to test for structural changes in demand for coffee in each economy. Results indicate a decrease in demand in the United States and an increase in the European Union. The decrease in US demand was larger than the growth of demand in EU at all price levels. The increase in Japan and the ROW were insignificant.

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The conditional marginal factor share estimates indicate a positive relationship between the Divisia volume index of total imports and the imports of green coffee in each economy. Of each additional dollar spent on green coffee in the world coffee market, US importers pay the largest proportion (48%) followed by the EU (39%), and Japan (4%). However, the average cost share of the US importers is 31% while that of the EU and Japan are 47% and 5%, respectively. Results also indicate that own price coefficients are all negative. However, only that of the rest of the world was statistically significant. None of the cross price parameter estimates were statistically significant, implying that there is no competition among the four economies.

Table 4 presents the conditional Divisia index elasticities and price elasticities calculated at the sample means. The Divisia index elasticity shows the percentage change in imports of green coffee in each economy for a one percent change in global imports. The Divisia index elasticity indicates a similar relationship as the total import elasticity (Washington and Kilmer, 2002). The Divisia volume index elasticities are all positive and statistically significant. With prices held constant, for a one percent change in global imports, US imports of green coffee change by 1.570 percent while imports of Japan and EU change by 0.828 percent and 0.811 percent, respectively.

The demand for green coffee in the three largest world economies is perfectly price inelastic, implying that a fall in prices does not lead to an increase in coffee imports in these markets. However, keeping global imports constant, a one percent decrease in price of green coffee leads to a 0.216 percent increase in the rest of the world import of green coffee.

Conclusions and Implications

The study was aimed at understanding the allocation of global import demand for green coffee among the world's largest economies using the differential production approach to the theory of the firm. Results confirm that the demand for coffee in EU and US has undergone significant changes over the past four decades. The US demand has decreased while that of EU increased. The level of decrease in the US was larger than that of the increase in the EU. Hence, given the large size of the US market, it was likely that the change in the US demand contributed to the decline of the world coffee market prices. Factors attributed to the decline in US demand include lifestyle changes and increased consumer awareness about the health effects of caffeine consumption (Houston, et al. 2003).

Based on the estimates of Divisia import index elasticities, we provide a sense of the response of each country's coffee industry to changes in the global coffee economy in relation to the total volume of global imports. Results indicate that the US demand is more sensitive than the Japanese and EU industries to changes in the global coffee economy. This implies that the US *market share* will increase with the expansion of the world coffee economy and decrease with the recession of the world coffee economy. The opposite will hold for the Japanese and EU coffee industries. This is evident in the fact that the US market share has been declining while that of EU and Japan have been increasing over the last three decades during which the world coffee economy has experienced a slow growth of demand (recessionary situation). These results imply that expansionary global trade policies (i.e. demand-side policies that will stimulate the global coffee demand) may reverse the declining trend of the US coffee market shares.

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Given the price inelasticity of the demand for coffee in the world's largest economies, producing countries will be worse off with the expansion of production. That is, the expansion of global export supply will worsen their terms of trade. Hence, we suggest that producing countries need to pursue new marketing strategies that involve market segmentation, value-adding activities, and forming and strengthening local and global organizations to establish direct market links with consumers and stabilize prices. Market segmentation through product differentiation is possible by raising the quality profile/reputation of individual origins, and selling this to consumers.

Exploiting the specialty coffee (high quality and specific origins) market is another option for producing countries. To their credit, specialty coffee outlets and traders in consuming countries are contracting with cooperatives to alter the way in which the market functions, so that producing countries may capture more of the income generated along the distribution chain. 'Fair trade' and 'conscious consumption' are two of the buzzwords under which such strategies are being explored. It appears that some consumers are willing to pay a premium for coffee products provided that producers receive just compensation (Ponte, 2002; Oxfam, 2002). It comes as no surprise that this approach is being opposed by most roasting companies.

Another promising option is to create and expand demand in non-traditional coffee consuming countries through market promotions. Possibly, it could eventually alleviate the sluggishness in global demand – particularly if new ways can be found to market coffee products in terms of certain lifestyle attributes, as is done in the US market.

Finally, it has to be noted that the success of the preceding options requires not only increased efforts by producing countries, but also more willingness and support

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from consuming countries. Given the nature of the coffee market, the strategies may not

be successful in all regions. Hence, to minimize the adverse developmental impact in the

short term, it may become necessary to provide technical services, marketing

information, and debt management schemes. Enlisting support from the ICO and various

international organizations would be worthwhile. With a view to the long term however,

governments of producing countries must encourage farmers to diversify their income

sources.

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Figure 1. Per capita consumption(kg/yr) of coffee in the three largest world economies from 1961-2002
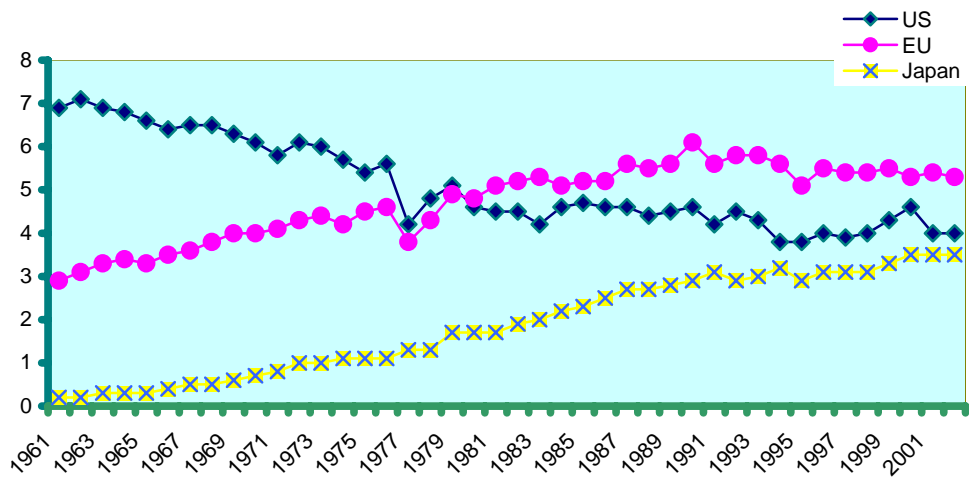
Source: FAO (2004)

Figure 2. Global import prices of green coffee from 1961-2003 (1989=100)
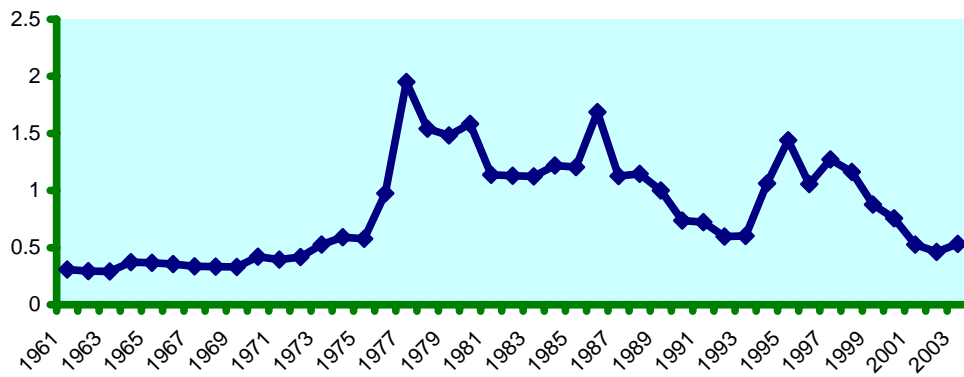
Source: FAO (2004)

Table 1. Likelihood Ratio (LR) Test Results for Autocorrelation in the Derived Demand for Coffee in World's Largest Economies

Model	Log-Likelihood Value	LR	$P\,[\,\chi^2_{(df)} \le LR\,] = 0.95$
AR (1)	427.375		
No AR (1)	421.489	11.772	3.84(1)

Table 2. Likelihood Ratio (LR) Test Results for Economic Constraints in the Derived Demand for Coffee in World's Largest Economies

Model	Log-Likelihood Value	LR	$P\,[\,\chi^2_{(df)} \le LR\,] = 0.95$
AR (1)	427.375		
Homogeneity	424.743	5.264	7.81(3)
Symmetry	422.520	4.446	7.81(3)

Table 3. Conditional Parameter Estimates of the Derived Demand for Coffee in the World's Largest Economies

Country	Intercept	Marginal Factor Shares	Price Coefficients			
			US	EU	Japan	ROW
US	-0.012**	0.482***	-0.074	0.047	0.020	0.007
	(0.005) [a]	(0.081)	(0.059)	(0.049)	(0.028)	(0.029)
EU	0.006**	0.385***		-0.062	-0.012	0.026
	(0.002)	(0.054)		(0.068)	(0.032)	(0.025)
Japan	0.003	0.040*			-0.013	0.004
	(0.002)	(0.025)			(0.012)	(0.014)
ROW[b]	0.003	0.093				-0.037*
	(0.003)	(0.063)				(0.019)

Table 4. Conditional Divisia and Price Elasticities of the Derived Demand for Coffee in the World's Largest Economies

Country	Divisia Elasticity	Conditional Price elasticity	Cross-Price Elasticities			
			US	EU	Japan	ROW
US	1.570*** (0.265) [a]	-0.242 (0.192)		0.154 (0.159)	0.066 (0.090)	0.021 (0.193)
EU	0.811*** (0.113)	-0.130 (0.143)	0.010 (0.103)		-0.024 (0.067)	0.055 (0.052)
Japan	0.828* (0.508)	-0.266 (0.240)	0.420 (0.573)	-0.239 (0.656)		0.385 (0.296)
ROW[b]	0.546 (0.374)	-0.216* (0.115)	0.039 (0.168)	0.153 (0.146)	0.024 (0.084)	

[a]Asymptotic standard errors are in parentheses
[b]Row is rest of the world
*** significance level = 0.01
** significance level = 0.05
* significance level = 0.1