THE STRUCTURE OF INTERNATIONAL DEMAND FOR SOYBEAN PRODUCTS

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Abstract

This study used a new body of quarterly data to estimate multilateral import demand relations for soybeans and soymeal. The countries of origin were the United States, Brazil, and Argentina. The areas of destination were the EEC, Japan, and Eastern Europe. The results indicated that own- and cross-price elasticities were quite large. These demand relations were then inverted and solved for prices to examine the effect on total revenue of increases in supplies from each of the exporting countries. Results showed that, in all cases except one, own-total revenue was inflexible with respect to increase in the own-quantity supplied. These results imply that an increase in exports will be associated with smaller proportional increase in revenue from exports.

The impact of international trade on the U.S. farm economy has been a subject of considerable professional interest over the past decade or more. One of the most important trade policy questions centers on the own-price elasticity of demand. If demand for some agricultural product is price-elastic, then acreage reduction programs will have perverse effects on gross farm income. Elastic demand for domestic farm products has been regarded as unrealistic and empirical studies support this position. However, given the multi-country nature of competition in many export markets, it is not difficult to conceive of elastic demand for individual countries' exports even though total demand for the product may be inelastic. If the export demand is elastic for a commodity that is exported, and if the export share is large, it is possible that total demand could also be elastic and that total revenue could fall as a result of restrictive farm policies.

One of the main shortcomings of existing international trade policy analyses is the lack of empirical estimates of demand by country of origin and country of destination, *i.e.*, the models did not take into account the multilateral nature of trade. Hence, from existing studies it is not possible to address the issue concerning the effect on a specific country's gross farm income of an increase in exports to a particular destination. For example, the work of Chambers and Just looked at total export demand for U.S. exports of corn, wheat, and soybeans. Demand was not differentiated by importing country and only one exporter, the U.S., was considered. At that time, the assumption that the U.S. was the sole exporter of these commodities was valid. However, over time, the number of exporters and trading partners has grown considerably.

The purpose of this paper is to present estimates of the demand structure for soybeans and soybean meal taking into account the multilateral nature of this trade. This demand structure is then used to compute the flexibility of total revenue from exports with respect to increases in the amount exported. A new quarterly data base is used, enabling the measurement of dynamic and seasonal effects in the demand for soybeans and meal.

MODEL SPECIFICATIONS AND DATA

The United States is the world's major producer (and consumer) of soybean products. Although it is also the world's major exporter, that status is currently being challenged by Brazil, and to some extent by Argentina (Williams and Thompson [1984a and 1984b]; Mielke). While the U.S. is still the major exporter of soybeans, Brazil, with its emphasis on in-house crushing, is now the major exporter of meal. Japan and the EEC are the major importers with Eastern Europe (including the USSR) emerging as a large, but sporadic, buyer in recent years. In this study, it is assumed that there exists product differentiation among the different suppliers. This assumption is supported by various quality characteristics of the U.S. and South American soybeans and soybean meal. An Agricultural Research Service study found that Argentine soybeans had more splits, lower moisture content, and lower oil content than U.S. soybeans.[1] This translates to half

[1] See *Feedstuffs* (August 17, 1987) vol. 59, No. 34.

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a pound more oil per bushel for U.S. soybeans. Brazilian soybeans, on the other hand, were discolored and suffered from heat damage. A Foreign Agricultural Service study compared the Brazilian and U.S. soybeans which were exported to Japan and found that U.S. soybeans contain significantly higher foreign substances, higher moisture levels, higher oil content, and slightly higher protein levels.[2] However, in later years, evidence has emerged that Brazilian soybeans contain higher protein levels than the U.S. beans and therefore shipments of Brazilian soybean meal contain higher protein levels.

In order to appropriately model the international demand for beans and meal by country of origin and destination, a two-stage demand process was chosen. In this process, the importing country first makes a decision on how much to spend in total on bean or meal imports. This decision is based on a price index of beans or meal, the overall price level, gross national product of the importing country, and several dynamic and seasonal factors to be discussed later. This is called the first stage allocation.

This stage decision model is written as:

$$(1) \quad W_{it} = \Phi_i + \omega_i \ln P_{it} + \Psi_i \ln D_{it} + \delta_i \ln X_{it} \qquad i = 1, \ldots, m,$$

where $W_{it} = M_{it}/Y_{it}$, M_{it} is the total amount spent by country i on beans in period t, Y_{it} is nominal GNP, D_{it} is the overall GNP deflator, $X_{it} = Y_{it}/D_{it}$, and m is the number of importing countries. P_{it}, defined below by (4), is, in effect, the price of all soybeans being imported by country i. Hence, the first stage demand relation, given by (1), is similar to an Almost Ideal Demand Systems (AIDS) for two goods: beans and all other goods. The first stage demand model was given a dynamic dimension by specifying,

$$(2) \quad \Phi_i = \eta_{io} + \eta_{il} M_{it-1} \qquad i = 1, \ldots, m.$$

Next, in the second stage allocation procedure, the importing country decides how to allocate the total bean or meal expenditure among the supplying countries. The functional form used for these second stage demand relations was also based on the well-known Almost Ideal Demand System,

$$(3) \quad w_{ikt} = \alpha_{ik} + \sum_{(j=1)}^{n} \gamma_{ikj} \ln p_{ijt} + \beta_{ik} \ln(M_{it}/P_{it}) \quad i = 1, \ldots, m; \ k = 1, \ldots, n,$$

where w_{ikt} is the budget share that the ith importing country spends on beans from the kth exporting country in time period t, *i.e.*, $w_{ikt} = p_{ikt}q_{ikt}/M_{it}$, and where p_{ikt} and q_{ikt} are, respectively, the price and quantity of beans purchased by the ith importer from the kth exporter, and M_{it} is as defined above. In this system there are m importers and n exporters. The price index P is defined as:

$$(4) \quad \ln P_{it} = \sum_{k=1}^{n} \overline{w}_{ik} \ln p_{ikt} \qquad i = 1, \ldots, m,$$

where $\overline{w}_{ik}$ is the sample mean budget share for the i^{th} importer.

Two additional dimensions were introduced to the standard AIDS model. The first was a dynamic or habit effect to account for the effect of past decisions on current choices.[3] The other dimension that was added was the introduction of seasonal effects which is discussed later. Both are important since the model was based on quarterly data. The habit effect was added by specifying the intercept as

$$(5) \quad \alpha_{ik} = \rho_{iko} + \sum_{j=1}^{n} \rho_{ikj} \, p_{ijt-1} q_{ijt-1} \qquad i = 1, \ldots, m; \ k = 1, \ldots, n.$$

This study utilized quarterly data from 1976I to 1984IV. Prior to the late 1970s Brazil and Argentina were not prominent participants in the world soybean market. Due to this fact and the difficulty of obtaining some of the earlier data, the time period is somewhat limited. These quarterly data are better suited to capture the dynamic effects if they are present. Past studies have relied exclusively on annual data. For the present study, U.S. export data by country of destination were obtained from *U.S. Exports: Schedule B* (Bureau of the Census), while price data were collected from various issues of *Soybean Digest Blue Book* (American Soybean Association). Export data for Brazil were received from the Economic Research Service, USDA and *Oil World* (ISTA: West Germany). Brazilian price data were supplied by Fundacao Getulio Wargas, Instituto Brasiliero de Economic in Rio de Janeiro. Ex-

2 See Holz (1985).

3 Lagged dependent variables have long been used to represent habit and dynamic effects in demand analysis. See Houthakker and Taylor (1966) for single equation applications, and Pollak and Wales (1969) for demand systems applications. This study followed Blanciforti and Green (1984) in using the expenditure and not the dependent variable (here the budget share) as the dynamic factor. This study followed Bowden (1972) in using the lagged expenditures of all of the trading partners. The Bowden approach is also consistent with the estimation procedure used here.

port and price data for Argentina were received via personal correspondence with the Junta Nacional de Granos, Buenos Aires.

As noted above, use of quarterly data is especially crucial for the measurement of the dynamic effects. Quarterly data also make it possible to measure the seasonal effects on bean and meal trade. In recognition of these seasonal effects, the intercept terms (2) and (5) were further modified as

$$\text{(2a)} \quad \Phi_i = \eta_{io} + \eta_{i1} M_{it-1} + \pi_{i1}S_I + \pi_{i2}S_{II} + \pi_{i3}S_{III} \qquad i = 1,\dots,m,$$

and

$$\text{(5a)} \quad \alpha_{ik} = \rho_{iko} + \sum_{j=1}^{n} \rho_{ikj}\, p_{ijt-1}\, q_{ijt-1} + \pi_{i1}S_I + \pi_{i2}S_{II} + \pi_{i3}S_{III} \qquad i = 1,\dots,m;\ k = 1,\dots,n$$

where S_l (l=I,II,III) is a dummy variable for the lth quarter.

Hence, (1) in conjunction with (2a) constitutes the first stage demand relation, while (3) along with (5a) is the second stage. It should be noted that the computation of demand elasticities in a system such as this is somewhat tedious. Briefly, the total price elasticity including both the first and second stage,

$$\text{(6)} \quad e_{ij,ik} = (\partial q_{ij}/\partial p_{ik})\,(p_{ij}/q_{ik}),$$

is computed as

$$\text{(7)} \quad e_{ij,ik} = e^*_{ij,ik} + e^M_{ij}\, e^{Mi}_p$$

where $e^*_{ij,ik}$ is the (partial) price elasticity computed from (3), e^M is the expenditure elasticity computed from (3), and e^{Mi}_p is given by

$$\text{(8)} \quad e^{Mi}_p = (\partial M_{ij}/\partial p_{ik})\,(p_{ij}/M_{ik})$$

and is computed from (1).[4] In performing the estimation, the restrictions of economic theory were imposed on the second stage demand relations country by country, or,

$$\text{(9a) Adding up:} \quad \sum_{k=1}^{n} \rho_{iko} = 1 \qquad i = 1,\dots,m$$

$$\sum_{k=1}^{n}\sum_{j=1}^{n} \rho_{ikj} = 0 \qquad i = 1,\dots,m$$

$$\sum_{k=1}^{n} \beta_{ik} = 0 \qquad i = 1,\dots,m$$

$$\text{(9b) Homogeneity:} \sum_{j=1}^{n} \gamma_{ikj} = 0 \qquad i = 1,\dots,m;\ k = 1,\dots,n$$

$$\text{(9c) Symmetry:} \quad \gamma_{ikj} = \gamma_{ijk} \qquad (k=j) \quad i = 1,\dots,m.$$

ESTIMATES AND RESULTS

The above relations were estimated by the Seemingly Unrelated Regression technique for each importing country for each product. The restrictions, (9a)-(9c), were imposed in each case. The results are given in Appendices A, B, and C. Appendix A contains the coefficient estimates for soybeans and meal demanded by the EEC from the U.S., Brazil, and Argentina. Appendix B given Eastern Europe's (including the USSR) demand for beans from the U.S. and Argentina and its demand for meal from the U.S. and Brazil. Eastern Europe does not import beans from Brazil or meal from Argentina. Appendix B also gives the estimates for Japan meal demand from the U.S. and Brazil. Argentina does not supply the Japanese market. Appendix C gives the OLS estimates of the first stage demand relation, (1) and (2a). Since data were not available on the GNP for Eastern Europe, no first stage relation was estimated.

The estimated relations indicate the following conclusions. In approximately half of the cases the price effects were significant, *i.e.*, t-ratios greater than 2.0. By the same criterion, slightly less than half of the dynamic effects were significant. Seasonal effects were generally not significant, although Eastern Europe's meal imports from both the U.S. and Brazil showed significant effects for all seasons. This result is somewhat surprising since South America's exporters are considered to exploit seasonal price patterns due to the timing of production in that region compared to the harvest period in the U.S. However, it should be kept in mind that these are demand relations and that the seasonal exploitation effects relate mainly to supply side considerations. The effects of GNP, and expenditure were generally not significant, although it should be remembered that zero coefficients on these variables imply unitary elasticities.

As indicated above, the primary interest in estimating these demand relations is to obtain estimates of the price, expenditure, and GNP elasticities of demand. These elasticities are given in Table 1. The first two entries in row 1 give the own- and cross-price elasticities for the EEC's demand for beans and meal from the U.S., Brazil, and Argentina. The de-

[4] It should also be noted that in the AIDS model, if the coefficient on expenditure (M) in (3) is zero, the expenditure elasticity is unity.

Table 1. Demand Elasticities for Beans and Meal by Importing Country

	Price Elasticities			Income Elasticities	
Country of Origin	United States	Argentina	Brazil	Expenditure	GNP
Bean Demand by the EEC					
United States	-4.03	19.88	4.01	1.18	2.76
Argentina	2.61	-18.5	-2.84	0.39	0.91
Brazil	0.24	-1.42	-1.56	0.04	0.09
Meal Demand by the EEC					
United States	-3.11	1.17	1.49	0.33	-0.92
Argentina	0.1	-9.35	0.3	1.51	-4.28
Brazil	2.68	7.74	-3.31	0.54	-1.53
Bean Demand by Eastern Europe					
United States	-5.54	12.11		1.08	
Argentina	4.46	-12.89		0.92	
Meal Demand by Eastern Europe					
United States	0.02		-0.61	1.36	
Brazil	-1.38		-0.18	0.64	
Meal Demand by Japan					
United States	-1.03		0.04	1.02	2.41
Brazil	0.01		-1.01	0.98	2.31

mand relations are read across the tables. Hence, the EEC own-price elasticity of demand for U.S. beans is - 4.03, the cross-price elasticity for Argentine beans is 19.88, the EEC expenditure elasticity of demand for U.S. beans is 1.18, and the GNP elasticity is 2.76. As is apparent, the own- and cross-price elasticities are very large in absolute magnitude. Two facts should be borne in mind. First, there are no previous estimates of these multilateral trade elasticities, *i.e.* no estimates of the demand by country i for country k's soybeans. Second, one should expect these elasticities to be large since they reflect the substitution possibilities between countries exporting similar, but not identical products. The results also indicate very low expenditure and GNP elasticities for Brazilian beans, which is consistent with the Brazilian government's program of exporting few beans in order to encourage the domestic crushing industry.

The results for the EEC demand for meal are somewhat similar. Again, the own- and cross-price elasticities are very high, indicating a great deal of substitution among these products. The negative GNP elasticities are troublesome. We note that although the point estimates yield negative GNP elasticities, the coefficient on GNP in the second stage relations for EEC meal is not significantly different from zero, implying a unitary GNP elasticity.

The next two entries in Table 1 give the elasticity estimates for Eastern Europe's demand for beans from the U.S. and Argentina and their demand for meal from the U.S. and Brazil. Again, the own- and cross-price elasticities are very high for the case of beans, but much lower for the meal demand. Also, the cross-price effects for meal are negative, which, while not necessarily implying that the goods are not substitutes, is difficult to justify. The results may have been affected by the nature of the Eastern European centrally planned economies. For these countries, import decisions are often motivated by political rather than economic rationale.

Lastly, Table 1 gives the estimates for meal demand by Japan, which imports beans in significant amounts only from the U.S. In this case, the own-price elasticities are close to unity with virtually no cross-price effects. It is apparent from the results in Appendix B that the AIDS model produced estimates with a low R^2. It is also conceivable that Japan is not price-responsive to imports of meal. This assertion is evident, particularly in the literature on wheat (Carter; Thursby and Thursby) which explores the possibility that economic variables such as world price or exchange rates do not influence the level of Japanese imports.

The above elasticities generate some important implications. First, the increased competitiveness in world markets for particular commodities is clearly evident in the world soybean market. This is reflected by the large own- and cross-price elasticities. Second, while the large cross-price elasticities indicate the possible substitution among different exporters, the large own-price elasticities also indicate the increased availability of other high protein feed substitutes.[5] The above estimates reflect, on the one

[5] Prices of high protein substitutes were tried in the first stage estimation without success.

hand, the entrance of new competitors into the market, while on the other hand they point to the political economy of agricultural trade in certain areas where political rather than economic forces motivate trade.

EFFECT ON TOTAL REVENUE

As mentioned in the introduction, the structure of demand plays an important role in determining the effect on total revenue of an increase in the quantity exported. In this section the estimates from the demand structure were used to make estimates of the flexibility of total revenue with respect to quantities offered in the export market. In order to make these estimates it is necessary to consider the inverse demand relations from the above regular or Marshallian demand relations. The inverse demand relations give the price for the particular good in question as a function of the quantities of all other goods and expenditure.

Inverse demand relations yield the well-known flexibilities of agricultural policy analysis. The flexibility of total revenue with respect to a change in quantity offered will be given by the own-quantity flexibility plus one. Similarly, the effect on one country's revenue of a change in another country's quantity offered can be calculated from the cross-quantity flexibility. For example, the effect on U.S. gross farm income from an increase in U.S. soybean exports to the EEC will be given by one plus the flexibility of U.S. price with respect to U.S. exports to the EEC.

Unfortunately, the AIDS demand system does not yield analytic expressions for the inverse demand relations. In order to circumvent this problem, the AIDS demand relations were first cast in a double-log demand form by utilizing the elasticities at the mean levels used to compute them in Table 1. Although these relations hold only at the means of the prices, the approximation should be fairly good because we are dealing only with derivatives. Given a double-log demand system, the flexibilities can easily be computed along the lines given by Houck in his classic article on the subject. Table 2 gives the total revenue flexibilities for the demand systems corresponding to Table 1.

Table 2. Flexibility of Total Revenue with Respect to Quantity Offered

	Quantity of Beans to EEC from		
Total Revenue for	United States	Argentina	Brazil
United States	0.17	-0.85	-0.60
Argentina	-0.11	0.82	0.03
Brazil	-0.03	0.03	0.24

	Quantity of Meal to EEC from		
Total Revenue for	United States	Argentina	Brazil
United States	0.42	-0.32	-0.29
Argentina	-0.02	0.87	-0.02
Brazil	-0.53	-0.56	0.41

	Quantity of Beans to E. Europe from	
Total Revenue for	United States	Argentina
United States	0.26	-0.69
Argentina	-0.26	0.68

	Quantity of Meal to E. Europe from	
Total Revenue for	United States	Argentina
United States	1.22	-0.72
Argentina	-1.66	0.98

	Quantity of Meal to Japan from	
Total Revenue for	United States	Brazil
United States	0.03	-0.04
Brazil	-0.01	0.01

The first entry in Table 2 lists the total revenue flexibilities with respect to shipments of beans to the EEC. Each column represents the revenue flexibility with respect to an increase in exports to the EEC from a particular country—the U.S., Argentina, or Brazil. For example, the top left entry (0.17) is the flexibility of U.S. revenue with respect to an increase in quantity of U.S. beans sold to the EEC. The cross-revenue flexibilities are 0.11 and -0.03 for Argentina and Brazil, respectively. Argentina has the largest own-revenue flexibility at 0.82. The impact of increased bean exports by the U.S. and Argentina to the EEC has very little impact on Brazilian revenues, due perhaps to the large emphasis given in Brazil to the export of processed beans.

The revenue flexibilities with respect to exports of meal to the EEC are reported in the second set of entries in Table 2. The own-revenue flexibilities for meal are generally larger than the flexibilities with respect to exports of beans to the EEC. Brazil's revenues seemed most affected (negatively) by increased meal exports to the EEC by the U.S. and Argentina which is indicated by the respective cross-revenue flexibilities of -0.53 and -0.56. On the other hand, Argentina seemed to be the least affected, as indicated by the -0.02 cross-revenue flexibility for an increase in meal exports to the EEC by both the U.S. and Brazil. These results are a reflection of the importance of the EEC as a market outlet for Brazilian soybean meal and the relatively small market share that Argentina holds in that market.

The revenue flexibilities with respect to bean and meal exports to Eastern Europe are reported in the next two entries. The U.S. revenues seem to be more affected by increased bean exports to Eastern Europe by Argentina than vice versa. The U.S. own-revenue flexibility with respect to meal exports to Eastern Europe was flexible at 1.22, while the cross flexibility was also less than unity at -1.66. This result is indicative of the low own-price elasticity of demand for U.S. meal in Eastern Europe. Thus an increase in the quantity exported to Eastern Europe as a result of increased demand for U.S. meal will be associated with higher prices and larger proportional increases in revenues.

The revenue flexibilities with respect to meal exports to Japan were small, as indicated by the last entry in Table 2. These results are not surprising, as the own-price import demand flexibilities are close to unity and the cross-price flexibilities approach zero.

CONCLUSIONS

This study attempted to estimate the demand for soybeans and soybean meal by disaggregating demand according to country of origin and destination. Two-stage import demand relations were estimated for the EEC, Eastern Europe, and Japan for meal and beans from the U.S., Brazil, and Argentina. In estimating these relations, problems of data accuracy and multicollinearity were recognized, especially among the price series. The main finding of this research is that the own- and cross-price elasticities of demand are much greater than those which have traditionally been found in market level aggregate studies. This finding is supported by a recent study by Alston *et al.* who found bilateral demand elasticities for U.S. cotton to be large. That study also found that the AIDS model produced larger elasticities than did another disaggregated model (the Armington model) to which it was compared. The research reported here also found evidence that habit, or dynamic, effects play a significant but not an overwhelming role in these demand relations. Seasonal effects were not particularly significant, except in the case of Eastern Europe. The effects of GNP on demand were somewhat mixed and of questionable significance.

The large demand elasticities found in this study point to the fact that both Brazil and Argentina have emerged as major competitors in the international soybean and soybean meal markets. No longer is the U.S. the dominant supplier, and importing countries face the opportunity of diversifying their buying behavior. The U.S. will continue to face strong competition, particularly in the meal market where both Brazil and Argentina have instituted various policies aimed at promoting domestic crushing and exports of processed products. It is important for the U.S. to try to maintain market shares as well as to explore new potential markets in light of the increased competition. This can be achieved through the production of high quality beans, while the changing environment in Eastern Europe can provide new export opportunities.

The estimated demand relations were then inverted in order to measure the impact on gross farm income of a change in exports by each of the exporting countries. The revenue flexibilities were relatively small except in the Eastern European meal market. The own-revenue flexibility of U.S. meal exports to that region of 1.22 suggests that the U.S. should try to direct increased emphasis toward exporting meal to that region. In general, increased exports by the U.S. of beans and meal were associated with a small decline in revenues for Argentina and Brazil. On the other hand, increased exports by Argentina or Brazil led to a more significant decline in U.S. revenues.

REFERENCES

Alston, Julian M., Colin Carter, Richard Green, and Daniel Pick. "Whither Armington Trade Models." *Am. J. Agr. Econ.*, 72(1990): 455-467.

Blanciforti, Laura and Richard Green. "An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups." *Rev. Econ. Stat.*, 65(1983): 511-516.

Bowden, Roger J. *The Econometrics of Disequilibrium.* New York: North-Holland, 1978.

Carter, Colin. "Japanese Wheat Imports: The Role of Politics and Economics." Unpublished manuscript, UC Davis, December 1986.

Chambers, Robert G. and Richard E. Just. "Effects of Exchange Rate Changes on U.S. Agriculture: A Dynamic Analysis." *Am. J. Agr. Econ.*, 63(1981): 32-46.

Holz, Alan E. "Trip Report: Soybean Quality Conference. Tokyo/Osaka." U.S. Department of Agriculture, Foreign Agricultural Service. December, 1985.

Houck, James P. "A Look at Flexibilities and Elasticities." *J. Farm Econ.*, 48(1966): 225-232.

Houthakker, H.S. and Lester Taylor. *Consumer Demand in the United States, 1929-1970.* Cambridge: Harvard University Press, 1966.

Mielke, Myles J. "Argentine Agricultural Policies in the Grain and Oilseed Sectors." U.S. Department of Agriculture, ERS, Foreign Agricultural Economic Report No. 206, 1984.

Pollak, Robert A. and Terrance J. Wales. "The Estimation of the Linear Expenditure System." *Econometrica.* 37(1969): 611-628.

Thursby, Marie C. and Jerry Thursby. "Strategic Trade Theory and Agricultural Markets: An Application to Canadian and U.S. Wheat Exports to Japan." *Imperfect Competition and Political Economy: The New Trade Theory in Agricultural Trade.* C.A. Carter, A.F. McCalla and J.A. Sharples, eds. Boulder, CO; Westview Press, 1990.

Williams, G.W. and R.L. Thompson. "The Brazilian Soybean Industry, Economic Structure and Policy Interventions." U.S. Department of Agriculture, ERS, Foreign Agricultural Economic Report No. 200, 1984.

Williams, G.W. and R.L. Thompson. "Brazilian Soybean Policy: The International Effects of Intervention." *Am. J. Agr. Econ.*, 66(1984): 488-498.

APPENDIX A

Parameter Estimates of Second Stage AIDS for Bean and Meal Demand by EEC from U.S., Brazil, and Argentina[a]

	Beans			Meal		
Variable	**U.S.**	**Brazil**	**Argentina**	**U.S.**	**Brazil**	**Argentina**
Intercept	-.214	.335	.879	2.21	-1.36	.149
	(.32)	(.78)	(1.35)	(2.56)	(1.78)	(.70)
Prices:						
U.S.	-2.53	.244	2.29	-1.50	1.50	-.003
	(3.04)	(.68)	(3.27)	(2.39)	(2.67)	(.02)
Brazil	.244	-.045	-.199	1.50	-1.72	.214
	(.68)	(.17)	(.61)	(2.67)	(3.18)	(1.47)
Argentina	2.29	-.199	-2.09	-.003	.214	-.212
	(3.30)	(.61)	(2.92)	(.02)	(1.47)	(2.73)
Dynamic Effects:						
U.S.	.0000126	-.0000053	-.0000073	.000047	-.000030	.000017
	(1.81)	(.24)	(.21)	(.55)	(.40)	(.78)
Brazil	-.000193	.000108	.000085	-.000017	.000053	-.000036
	(1.78)	(1.48)	(.73)	(.22)	(.73)	(1.49)
Argentina	-.000092	-.000053	.00014	.00073	-.00096	.00023
	(1.50)	(1.26)	(2.19)	(1.39)	(2.10)	(1.57)
Seasonal Effects:						
Winter	-.067	-.0006	.068	.114	-.090	-.024
	(.73	(.01)	(.69)	(1.67)	(1.49)	(1.43)
Spring	-.132	.0427	.089	.0288	-.0235	-.0053
	(1.41)	(.73)	(.93)	(.27)	(.25)	(.20)
Summer	-.253	.0556	.197	-.113	.0882	.0244
	(2.97)	(1.01)	(2.22)	(1.60)	(1.40)	(1.42)
Expenditure	.146	-.036	-.110	-.274	.289	-.0143
	(1.81)	(.68)	(1.37)	(2.31)	(2.75)	(.48)
Mean Budget Share	.827	.059	.114	.406	.563	.031
$\overline{R}^2$	.826	.371	.683	.749	.785	.556

[a]The numbers in parenthesis below the coefficient estimates are the t-ratios.

APPENDIX B

Parameter Estimates of Second Stage AIDS for Bean and Meal Demand by Eastern Europe from U.S., Brazil and Argentina[a]

	Beans		Meal	
Variable	**U.S.**	**Argentina**	**U.S.**	**Brazil**
Intercept	.657 (4.00)	.343 (2.09)	-.192 (.27)	1.192 (1.69
Prices				
U.S.	-3.266 (1.38)	3.266 (1.38)	.350 (.74)	-.350 (.74)
Competing Country	3.266 (1.38)	-3.266 (1.38)	-.350 (.74)	.350 (.74)
Dynamic Effects				
U.S.	.0000067 (.03)	-.0000067 (.03)	.000372 (1.24)	-.000372 (1.24)
Competing Country	-.00132 (2.65)	.00132 (2.65)	-.000643 (2.85)	.000643 (2.85)
Seasonal Effects				
Winter	-.00927 (.06)	.00927 (.06)	.1346 (1.50)	-.1346 (1.50)
Spring	-.1824 (1.06)	.1824 (1.06)	-.2536 (2.48)	.2536 (2.48)
Summer	-.1973 (1.12)	.1973 (1.12)	-.2356 (2.78)	.2356 (2.78)
Expenditure	.0554 (2.19)	-.0554 (2.19)	.1346 (1.08)	-.1346 (1.08)
Mean Budget Share	.727	.273	.372	.628
$\bar{R}^2$	.376	.376	.628	.628

[a]The numbers in parenthesis below the coefficient estimates are the t-ratios.

APPENDIX C

Estimates of First Stage Demand Model for Expenditure on Beans and Meal by EEC and Japan

	EEC		JAPAN	
Variable	**Beans**	**Meal**	**Beans**	**Meal**
Intercept	-.0037	.00018	-.00439	.0000937
	(.85)	(.02)	(3.51)	(.18)
Prices:				
Soybean	.00110	.00073	.000365	.000039
	(3.20)	(3.37)	(6.72)	(2.30)
CPI	-.00117	.00049	-.000489	-.000069
	(2.12)	(1.30)	(6.07)	(1.43)
GNP	.00169	-.00249	.00042	-.0000206
	(.90)	(.90)	(2.09)	(.23)
Dynamic Effect	-.3451	-.552	-.2862	-.1957
	(1.79)	(2.36)	(2.31)	(.79)
Seasonal Effects:				
Winter	.423E-07	.000081	-.000016	5.488E-07
	(.02)	(1.43)	(.55)	(.14)
Spring	-.000098	.000108	-.000036	.0000017
	(.70)	(1.86)	(1.37)	(.41)
Summer	-.000507	.000050	-.000087	2.037E-07
	(3.61)	(.86)	(3.27)	(.05)
Mean Budget Share	.00126	.00065	.00031	.0000131
$\bar{R}^2$	.606	.695	.693	.351
D.W.	1.42	2.60	1.52	1.48