The Impact of Brazil and Argentina's Currency Devaluation on U.S. Soybean Trade

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Abstract

We analyzed the effects of Brazil and Argentina's currency devaluation on the U.S. soybean import demand in major importing countries. Results indicate that nominal exchange rates between the United States and importers affect the U.S. soybean export market. Additionally, we found evidence that currency depreciations have favored soybean exports from Argentina and Brazil at the cost of reduced exports from the United States. Increased world soybean demand has promoted export sales from major producers, affecting export prices. Adoption of GM soybeans in the United States has been a determinant in decreased U.S. soybean import demand.

***Key Words*:** currency devaluation, EC3SLS, exchange rates, soybeans, third-country effect.

Introduction

The soybean export market is a significant contributor to U.S. agricultural export income. In 2004, exports of soybeans and soybean products comprised 78 percent of the total U.S. exports of oilseeds, meals, and vegetable oils, with earnings totaling about eight billion dollars. Although the United States still dominates the soybean export market, the U.S. share in major importing countries is being displaced by exports from several competitors, particularly Brazil and Argentina. These countries have benefited from reduced costs in production, marketing, and transportation as a result of political and economic reforms and infrastructure development. Furthermore, currency devaluation in Argentina and Brazil may also be an important factor underlying the declining role of U.S. soybeans in world markets. The decision by Brazil to devalue the real in 1997 and the subsequent devaluation of the peso by Argentina in 2002 have caused a major uproar among U.S. stakeholders. Farmers and exporters have claimed that

because Brazil and Argentina decreased the value of their currencies relative to the value of the U.S. dollar, soybeans from the United States are more expensive than their competitors' products. As U.S. farmers are losing their competitive edge in the world soybean market, it becomes necessary to take actions to sustain U.S. exports.

Several works have studied the effect of exchange rate changes on agricultural markets. Most have concluded that exchange rate fluctuations affect the actual price paid for products; therefore, importers adjust demand among alternative sources of supply. The majority of work in this area has concentrated on bilateral interactions between importers and exporters; less attention has been given to the effect of competitors' exchange rate changes on exports by a specific country.

The objective of our study is to analyze the impact of the Brazilian and Argentinean currency devaluations on U.S. soybean import demand by major importing countries: China, Germany, Indonesia, Japan, Mexico, the Netherlands, Korea, Spain, and Thailand. Previous studies have not estimated competitors' exchange rate effects on the performance of U.S. soybean exports. Quantification of this relationship will provide valuable insight for designing strategies for U.S. producers and exporters to compete more effectively in order to retain world market shares.

The paper is organized in the following way: we begin by presenting an overview of relevant research on exchange rates and agricultural products. Trends for soybean production and trade are discussed in the next section. The subsequent section describes the model, estimation techniques, and data sources. Empirical results are then discussed, and the final section consists of summary and conclusions.

Literature Review

Schuh (1974 and 1976) instigated the study of exchange rate changes and their effect on the performance of agricultural trade. From his work, a line of research was developed to evaluate the effect of nominal and real exchange rates on domestic and foreign markets for agricultural commodities (Chambers and Just, 1979 and 1981; Greenshields; Johnson, Grennes, and Thursby; Batten and Belongia). The majority of researchers concluded that prices and exports of agricultural commodities are sensitive to changes in exchange rates. Recent research has focused on the effect of exchange rate uncertainty on trade of agricultural commodities (Anderson and Garcia; Batten and Belongia; Haley and Krissoff; Bessler and Babula; Pick; Maskus; Klein; Langley, et al.). The majority of evidence indicates that exchange rate uncertainty depresses trade of agricultural products.

Most of the works in the exchange rate literature have concentrated on bilateral interactions between importers and exporters, but Cushman, and Jin, Cho, and Koo included a third-country effect to evaluate competition among alternative importers and exporters, respectively. These researches argument to include currency information on competing countries is that omission of third-country effects could bias the analysis of bilateral trade flows (Cushman). Both investigations found evidence of third-country risk effects; however, Jin, Cho, and Koo concluded that a competitor's exchange rates are not relevant in their case, which focused on determining U.S. wheat market shares in Asian countries.

For soybeans, exchange rate changes have been found to exercise a significant impact on trade (Anderson and Garcia; Chambers and Just, 1981; Sarwar and Anderson). For instance, Anderson and Garcia concluded that short-term variations in nominal exchange rates reduce the volume of U.S. soybeans traded with major importers, and that the effect varies across countries.

In contrast, Greenshields reported that exchange rate changes have little effect on soybean exports from the United States.

Trends in Soybean Production and Trade

Production

The United States, Brazil, and Argentina are the world's leading producers and exporters of soybeans, responsible for 80 percent of the world production. The United States produced 86 million metric tons in 2004, followed by Brazil and Argentina with 53 and 39 million metric tons, respectively. Additionally, production in Paraguay and Uruguay has grown significantly to 3.8 million and 0.5 million metric tons, respectively, in 2004. Projections for 2005 suggest production will increase by 25 percent for Brazil, while production in the United States is expected to decrease by 8 percent. Production in Argentina is expected to remain at the same level as last year.

According to Schnepf, Dohlman, and Bolling, economic and political reforms, infrastructure development, and enhanced use of agricultural inputs have promoted a good environment for agricultural production in Argentina and Brazil. As a result, Brazil and Argentina have the ability to market soybeans to Rotterdam at a lower cost than U.S. soybeans produced in the Corn Belt (Dohlman, Schenepf, and Bolling). Due to significant increases in yields and cultivated area, the potential for future production growth in Brazil is still substantial. However, market share gains would depend on exchange rate changes, economic stability, further infrastructure improvements, and policy reforms (Schnepf, Dohlman, and Bolling). For Argentina, future production may be constrained by limited land for agricultural production (Dohlman, Schenepf, and Bolling).

Trade

The soybean export market can be divided into three product categories: beans, oil, and meal. While the United States dominates the bean export market, Argentina is the principal exporter of meal and oil, followed by Brazil and the United States. China is the largest soybean importer in the world, followed by the European Union (EU) and Japan. Despite being a leading producer of soybeans, China contributes less than 0.5 percent to world soybean exports. By contrast, increased imports by China are substantially influencing world demand and therefore world soybean prices. In 2004, China imported about 22.8 million metric tons. During the same year, the EU-25 and Japan imported 15 million and 5 million metric tons, respectively. Within the EU, the major importing countries are Germany, Spain, and the Netherlands, while major importers of soybeans from Asia include Japan, Korea, Thailand, and Indonesia.

For the importing countries used in this study, Japan has been the major buyer of soybeans from the United States, followed by Mexico and China. For Brazil, major soybean exports have been sold to China, the Netherlands, Germany, and Spain. Although the volume of U.S. soybean exports to some of these countries has been increasing, there is a declining trend of market shares in all the selected importers, except Indonesia and Mexico. This situation results in an overall reduction in world market share for U.S. soybeans. In contrast, Brazil's soybean exports to China, Germany, Japan, the Netherlands, Korea, and Spain have substantially increased, while for Argentina, soybean exports to China and Thailand have also increased.

Genetically Modified (GM) Soybeans

In 1996, the United States introduced for commercial production Roundup Ready soybean, which is a GM crop with immunity to the herbicide glyphosate. Although Argentina and recently Brazil have legalized the production of GM soybeans (Matthey, Fabiosa, and

Fuller), the United States leads in the planting of GM soybeans, accounting for 87 percent on the total soybean producing area during 2005 (USDA Economic Research Service (ERS), 2005). Consumer concerns regarding GM products have been cited as a reason for decreased exports of U.S. soybeans, especially to the EU, Japan, and Korea (Ames; Nielsen and Anderson). However, other researchers have argued that changes in soybean prices are still the main factor in determining bilateral trade flows of soybeans (Ballenger, Bohman, and Gehlhar; Cunningham and Unnevehr).

Exchange Rates and Prices

Researchers have concluded that currency devaluations by Brazil and Argentina have been important factors in the decreased competitiveness of U.S. soybeans in world markets (Sampaio, Costa, and Gunter; USDA ERS, 2000). In the case of Brazil, substantial currency devaluation in relation to the U.S. dollar commenced in 1997. Further devaluations continued as a result of governmental measures in response to the financial crises in Asia and Russia, which increased concern among international investors and promoted the outflow of capital from Brazil (USDA ERS, 2000). In the case of Argentina, currency devaluations began in 2002 as a result of the country's domestic financial crisis.

On average, during 1993 to 2004, soybeans export prices have increased (USDA Foreign Agricultural Service (FAS)) and the price trends of Argentina, Brazil, and the United States soybeans have been almost identical. Because of the strong similarity in soybean export prices of major producers, currency adjustments could have strengthened exports of Argentina and Brazil by creating a price advantage over other competitors such as the United States. For instance, Rosson, Adcock, and Hobbs showed that, during 1996-1998, a 20 percent appreciation

of the U.S. dollar led to an 8 percent increase in U.S. soybean prices in Japan (from 989 ¥/bu to 1,068 ¥/bu). Consequently, Japanese purchases of Brazilian soybeans increased.

Model

Our model is developed from a general import demand function with the inclusion of exchange rate variables, based on work presented by Cushman, and Jin, Cho, and Koo. The model explains soybean imports by country *i* from a specific exporter *j* (M_i^j) as a function of country *i*'s total soybean imports (TM_i), country *j*'s soybean export price (P^j) relative to a weighted average of competitors' export prices (P^c), the exchange rate between importer *i* and exporter *j* (XR_i^j), and the exchange rate between importer *i* and a weighted average of other exporting countries (XR_i^c). The model is specified as:

$$M_i^j = f(TM_i, P^j / P^c, XR_i^j, XR_i^c) \quad (1)$$

The model assumes that imported soybeans are imperfect substitutes for domestically produced soybeans in importing countries (imperfect substitute model) and that imported soybeans from different sources are homogeneous (Goldstein and Khan). Importing countries decide the total amount of soybeans to purchase before deciding the amount of soybeans imported from alternative suppliers (Alston et al.). Therefore, the volume of soybean imports from a specific supplier will depend on the total amount of soybeans purchased from the world.

Export price of soybeans in exporting countries are included based on common demand theory applied to trade models, where imports in importing countries are a function of an exporting country's price and the price of its competitors (Goldstein and Khan). Because of the high correlation between soybean export prices of the United States and its major competitors,

Argentina and Brazil, the price variable is expressed as a ratio to avoid multicollinearity problems.

As previously mentioned, changes in exchange rates are expected to affect the actual price paid for imported agricultural products. As a result, as long as products are substitutable, importing countries will make adjustments in trade, manifested in changes in preference for alternative suppliers (Anderson and Garcia). Therefore, in our framework, soybean importers are concerned about their currency value relative to those of major supplying countries. For instance, Chinese importers are concerned about the value of the Yuan relative to the U.S. dollar, as well as the value of the Yuan relative to the Brazilian real and the Argentinean peso. The concept of including exchange rates of competing third countries in bilateral trade models, the "third-country effect", was introduced by Cushman, and extended by Jin, Cho, and Koo. Importer's income is not included in the model, since changes in aggregate income should not directly affect sources of imports, but only its level of aggregate soybean imports (Alston et al.).

Based on equation (1), two import demand equations are specified; one for the quantity of soybeans imported from the United States (M_{it}^{US}) and another for the quantity of soybeans imported from the rest of the world, mainly Argentina and Brazil (M_{it}^{AB}). For the United States, the introduction of GM soybeans in 1996 may have been an important factor for the lost of export sales to major importing countries. Therefore, for the U.S. import demand equation, the lag of the percentage area of GM soybeans planted (GMS_{t-1}) was used to represent the adoption of GM soybeans in the United States. The empirical specification of the equations is as follows:

$$\ln M_{it}^{US} = \alpha_0 + \alpha_1 \ln TM_{it} + \alpha_2 \ln P^{US} / P^{AB}{}_{it} + \alpha_3 \ln XR_{it}^{US} + \alpha_4 \ln XR_{it}^{AB} + \alpha_5 \ln GMS_{t-1} + \varepsilon_{it}^{US} \quad (2)$$

$$\ln M_{it}^{AB} = \beta_0 + \beta_1 \ln TM_{it} + \beta_2 \ln P^{AB} / P^{US}{}_{it} + \beta_3 \ln XR_{it}^{AB} + \beta_4 \ln XR_{it}^{US} + \varepsilon_{it}^{AB} \quad (3)$$

In these equations, *ln* stands for the natural log of the previously described variables and ε_{it}^{US} and ε_{it}^{AB} are the error terms for the United States and Argentina and Brazil equations, respectively. The error terms are assumed to be independent from the explanatory variables and normally distributed. The *i* index represents the importing countries, including China, Germany, Indonesia, Japan, Mexico, the Netherlands, Korea, Spain, and Thailand, and *t* indexes time periods.

It is expected that an increase in the total imports of soybeans in an importing country will include increased imports of soybeans from the United States. An increase in the U.S. soybean price, while the weighted average export price of competitors remains constant, would reduce the demand for U.S. soybeans. In contrast, an increase in the weighted average price would have the opposite effect. However, if an increase in a country's imports from an exporter is large, it would affect price of soybeans in the exporting country. In this case, the price is endogenous and has a positive relationship with imports. A rise in the value of the U.S. dollar, with respect to importers' currencies, results in an increase in the actual price paid for U.S. soybeans, thereby reducing the quantity demanded from the United States. Similarly, a decrease in the U.S. dollar value is expected to increase the quantity of soybeans demanded from the United States. An appreciation of the Argentinean and Brazilian currencies, relative to currencies of importing countries, will increase the price of their soybeans, causing increased demand from other soybean suppliers, such as the United States. However, if Argentina and Brazil depreciate their currencies, this would make their soybeans more attractive, and consequently increase their sales to importing countries. Finally, an increase in the adoption of GM soybeans is expected to reduce the demand for U.S. soybeans.

Estimation Procedure

Economic instability in Brazil and Argentina during the end of the 1980s and early 1990s affected the data required for our analysis. The span of time was limited to 10 years per importing country; therefore, pooling time series and cross-sectional units (panel data) provided a richer alternative for our estimation.

The import demand of soybeans from the United States and Argentina and Brazil can be simultaneously affected by some factors which were not included in Equations (2) and (3). Therefore, these equations are expected to be related through the error terms, such as $\text{cov}(\varepsilon_{it}^{US}, \varepsilon_{it}^{AB}) \neq 0$ (contemporaneous correlation). Under these conditions, Zellner showed that there is an efficiency gain if equations (2) and (3) are simultaneously estimated. Additionally, a time specific effect is included in the error term to account for substantial changes in world soybean trade during 1994-2003. [1]

Correlation of some of the right-hand side variables with the error term (endogeneity) is a potential econometric problem. In our equations, we expect prices and total imports to be endogenous. In the short-run, soybean demand by importing countries may affect export prices of soybeans in exporting countries. For this reason, there is the potential of a simultaneous relationship between export prices and imports, causing the price variable to be correlated with the error term. The total imports variable is expected to be endogenous because of omitted factors determining this variable. Importers first decide the total volume of soybeans to buy from the world based on income constraints and prices, and then they determine how much to buy from alternative suppliers (two-stage budgeting procedure) (Alston et al.). Therefore, the total import variable was instrumentalized using aggregate income, the import price of soybeans, and the import price of corn (Alston et al.). As instruments for the price variable we used the

ratios of total soybean exports and soybean production between the United States and the average of Argentina and Brazil.

The system of equations (2) and (3), along with the instrumental variables, was estimated using a two-way error component three-stage least squares methodology (EC3SLS). The EC3SLS estimator was derived by Baltagi (1981), and it performs better than an instrumental variable estimation in which the endogenous variables are replaced with their predicted values from separated regressions.

Finally, in order to analyze the potential of spurious regression and cointegration among the variables in our model, we evaluated the stationarity properties of the variables by implementing the Im, Pesaran, and Shin (IPS) and the Fisher ADF tests. At the 5 percent level, our results did not find statistical evidence of unit roots; therefore, inferences from our estimations may not be affected by the risk of spurious regression.

Data and Sources

The data used in this study consist of the volume of soybean imports from Brazil and Argentina and the United States by nine major importing countries: China, Japan, Germany, Spain, the Netherlands, Mexico, Thailand, Indonesia, and Korea. Information about soybean imports from Argentina and Brazil was not uniform across the period under study; therefore, this variable was computed from the difference between total imports and imports from the United States. The data are annual for the period 1994-2003, resulting in 90 observations. Soybean imports by the nine importing countries were obtained from the United Nations database COMTRADE. Export prices of soybeans, total production, and total exports of soybeans were collected from USDA FAS. The import price of soybeans and corn were computed by dividing total value by volume. Prices and income were converted into real values using CPI and GDP

deflators, respectively. These data were acquired from the International Monetary Fund (IMF). The nominal exchange rate between the United States and Argentina, the United States and Brazil, and the United States and the nine importing countries were obtained from Exchange Rates and Agricultural Trade data set published by the USDA ERS. The exchange rates were expressed in terms of importer's currency per unit of exporter currency. The percent of GM soybeans planted in the United States was obtained from the USDA ERS.

Empirical Results

Results from the estimation using EC3SLS are reported in table 1. For soybean imports from the United States, all the independent variables are significant and the direction of the effect is correct, except for the price variable. Results suggest that soybean imports from the United States increase as major importers increase their total demand of soybeans. Imports from the United States are negatively affected when the value of the U.S. dollar increases relative to the currency of major importing countries. Moreover, an increase in the ratio of importers' currency relative to the weighted average of Brazil and Argentina currencies, suggesting an appreciation of Argentina's peso and Brazil's real, causes soybean imports from the United States to increase. In contrast, if Brazil and Argentina depreciate their currencies, soybean imports from the United States will be expected to decrease. The adoption of GM soybeans in the United States has decreased the purchases of U.S. soybeans from major importers.

The export price ratio between the United States and its competitors, Argentina and Brazil, has a positive relationship with imports of soybeans from the United States. The positive relationship is due mainly to the nature of the data in the short-run. Economic theory indicates that in the long-run, the price of soybeans is determined by demand and supply. However, in the short-run, import demand for soybeans is affecting the price under a given supply. Currently,

export prices from all major exporters have been increasing as a result of increased world demand for soybeans, mainly by import growth from China. These short-run changes under a given supply result in a positive relationship between export prices and imports.

In the case of soybean imports from Brazil and Argentina, all the variables are significant, and have the expected signs, except for relative prices. The result for the ratio of prices was not expected and the reason for this outcome is explained in the previous paragraph. Results indicate that soybean imports from Brazil and Argentina increase due to increased total import demand from importing countries. Results provide evidence that a stronger U.S. dollar compared to importing countries' currencies will increase soybean imports from Brazil and Argentina. In contrast, an appreciation of the Argentinean peso and the Brazilian real, relative to the importers' currencies, is expected to decrease soybean imports from Brazil and Argentina. Under this scenario, importers will favor soybean imports from other countries, such as the United States.

Our results provide evidence that currency depreciation in Argentina and Brazil has resulted in decreased U.S. soybean imports by major importing countries. Because of the similarity among soybean export prices of the United States, Brazil, and Argentina, currency devaluations in Argentina and Brazil could have created an advantage over the United States in exporting soybeans. Moreover, the estimated parameters for Brazil and Argentina's import demand are higher than the ones for the U.S. import demand (table 1). This result favors Brazil and Argentina, as their soybean exports may be more responsive to income and price strategies oriented to improve their market shares.

Although the cost of producing soybeans is lower in Argentina and Brazil than in the United States, there are still some problems in terms of financial structure and inland

transportation (Dohlman, Schnepf, and Bolling). These may restrict Argentina and Brazil in producing the amount of soybeans necessary to cover increased world demand. Therefore, other competitors, such as the United States, Paraguay, and Uruguay, are still increasing export volumes, but not in the same proportion as Argentina and Brazil's exports.

Summary and Conclusions

This study evaluates the impact of U.S. trade of soybeans following Brazil and Argentina's currency devaluation during 1994-2003. It was motivated by substantial decline in U.S. soybean shares in major importing countries, which has been mainly attributed to exchange rates devaluations from major competitors. Past studies in soybean trade have not included the effect of competitors' exchange rates on U.S. soybean exports. Also, this study extends previous research by implementing EC3SLS procedure on a bilateral trade model for a single commodity. The analysis was performed for major soybean importers: China, Germany, Indonesia, Japan, Mexico, the Netherlands, Korea, Spain, and Thailand. We estimated two soybean import demand equations simultaneously: one for the United States and the other for both Brazil and Argentina. The system was estimated assuming endogeneity of total imports and relative prices.

Our results indicate that soybean imports from the United States have been affected by changes in exchange rate. The estimation provides evidence that a stronger dollar, relative to an importer's currency, decreases imports from the United States. Also, our results suggest that depreciation (appreciation) of Brazil and Argentina currencies, relative to major importers' currencies, decreases (increase) soybean imports from the United States. Additionally, increased adoption of GM soybeans in the United States has been a determinant in the decreased performance of U.S. soybean exports. Finally, it is also expected that increases in total imports

by importing countries would increase soybean exports from all exporting countries; however, Argentina and Brazil exports more than the United States.

Our results are comparable to previous research from Anderson and Garcia; Chambers and Just; and Sarwar and Anderson. These studies concluded that exchange rate changes have a significant impact on trade of soybeans. Moreover, we also found evidence that competitors' exchange rate affects U.S. trade of soybeans. Based on our findings, we conclude that effort needs to be directed to developing strategies that improve the cost advantage position of the United States in producing soybeans or strategies that allow quality differentiation that favors U.S. soybeans over other competitors.

[1] Each error term in our equations is decomposed in the following way: $\varepsilon_{it}^{j} = \mu_i^{j} + \lambda_t^{j} + \upsilon_{it}^{j}$, where *j* represents import demand equations. μ_i denotes unobserved importers specific effects, λ_t denotes unobserved time specific effects, and υ_{it} is the remainder stochastic disturbance term. It is assumed that μ, λ, and υ are independent from each other, moreover $\text{cov}(\mu_i^{US}, \mu_i^{AB}) \neq 0$, $\text{cov}(\lambda_t^{US}, \lambda_t^{AB}) \neq 0$, and $\text{cov}(\upsilon_{it}^{US}, \upsilon_{it}^{AB}) \neq 0$.

References

Alston, J., C. Colin, R. Green, and D. Pick. "Whither Armington Trade Models?" *American Journal of Agricultural Economics.* 72(1990):455-467.

Ames, G. "Bananas, Beef, and Biotechnology: Three Contentious U.S.-EU Trade Disputes." *Review of Agricultural Economics*. 23(2001):214-222.

Anderson, M., and P. Garcia. "Exchange Rate Uncertainty and the Demand for U.S Soybeans." *American Journal of Agricultural Economics*. 71(1989):721-729.

Ballenger, N., M. Bohman, and M. Gehlhar. *Biotechnology: Implications for U.S. Corn & Soybean Trade.* Washington, DC: U.S. Department of Agriculture Economic Research Service (ERS), Agricultural Outlook, 2000.

Baltagi, B. "Simultaneous Equation with Error Components." *Journal of Econometrics*. 17(1981):189-200.

Batten, D. and M. Belongia. "Monetary Policy, Real Exchange Rates and U.S Agricultural Exports." *American Journal of Agricultural Economics*. 68(1986):422-427.

Bessler, D. and R. Babula. "Forecasting Wheat Exports: Do Exchange rates Matter?" *Journal of Business, Economics and Statistics*. 5(1987):397-406.

Chambers, R. and R. Just. "A Critique of Exchange Rate Treatment in Agricultural Trade Models." *American Journal of Agricultural Economics*. 61(1979):249-257.

Chambers, R. and R. Just. "Effect of Exchange Rates Changes on U.S. Agriculture: A Dynamic Analysis." *American Journal of Agricultural Economics*. 63(1981):32-46.

Cunningham, C. and L. Unnevehr. "Market Segmentation for Genetically Modified Corn and Soybean Exports." International Consortium on Agricultural Biotechnology Research *Conference Proceedings*, 1999, pp. 638-650.

Cushman, D. "Has Exchange Risk Depressed International Trade? The Impact of Third-Country Exchange Risk." *Journal of International Money and Finance*. 5(1986):361-379.

Dolman, E., R. Schnepf, and C. Bolling. *Soybean Production Costs and Export Competitiveness in the United States, Brazil, and Argentina.* Washington, DC: U.S. Department of Agriculture ERS, Oil Crops Situation and Outlook OCS-2001.

Goldstein, M. and M. Khan. "Income and Price Effects in Foreign Trade." *Handbook of International Economics*. R. Jones and P. Kenen, eds. North Holland, 1985.

Greenshields, B. *Changes in Exchange Rates: Impact on U.S. Grain and Soybean Exports to Japan.* Washington, DC: U.S. Department of Agriculture ERS, No. 364, 1974.

Haley, S. and B. Krissoff. "U.S. Grain Exports and the Value of the U.S. Dollar." *Journal of Agricultural Economis Research.* 39(1987):12-21.

Hsiao, C. *Analysis of Panel Data*. New York: Cambridge University Press, 1986.

Johnson, P., T. Grennes, and M. Thursby. "Devaluation, Foreign Trade Controls, and Domestic Wheat Prices. *American Journal of Agricultural Economics*. 59(1977):619-627.

Jin, H., G. Cho, and W. Koo. "Third-Country Effects on the Market Shares of U.S. Wheat in Asian Countries." *Journal of Agricultural and Applied Economics.*" 36(2004):797-813.

Klein, M.W. "Sectoral Effects of Exchange Rate Volatility on United States Exports." *Journal of International Money and Finance.* 9(1990):299-308.

Langley, S., M.Giugale, W. Meyers, and C. Hallahan. "International Financial Volatility and Agricultural Commodity Trade: A Primer." *American Journal of Agricultural Economics*. 82(2000):695-700.

Maskus, K. "Exchange Rate Risk and U.S Trade: A Sectoral Analysis." *Federal Reserve Bank of Kansas Economic Review.* 3(1986):16-28.

Matthey, H., J. Fabiosa, and F. Fuller. *Brazil: The Future of Modern Agriculture?* Midwest Agribusiness Trade Research and Information Center, Briefing Paper No. 04-MBP 6, 2004.

Nielsen, C. and K. Anderson. *Global Market Effects of Alternative European Responses to GMOs.* Centre for International Economic Studies, Adelaide University, No. 0032, 2000.

Pick, D. "Exchange Rate Risk and U.S.Agricultural Trade Flows." *American Journal of Agricultural Economics*. 72(1990):694-700.

Rosson P., F. Adcock, and A. Hobbs. "Exchange Rate Impacts on U.S.Agriculture and the Potential Role of Dollarization." Working paper, Center for North American Studies, Department of Agricultural Economics, Texas A&M University, 2001.

Sampaio, L., E. Costa, and L. Gunter. "Brazil's Floating Exchange Rate and Competitiveness in the World Soybean Market. Paper presented at the International Conference of Agricultural Policy Reform and the WTO: where are we heading? Capri, Italy, June 23-26, 2003.

Sarwar, G. and D. Anderson. "Estimating US Soybean Exports: A Simultaneous Supply/Demand Approach." *Journal of Economic Studies.* 17(1990):41-56.

Schnepf, R., E. Dohlman, and C. Bolling. *Agriculture in Brazil and Argentina: Developments and Prospects for Major Field Crops.* Washington, DC: U.S. Department of Agriculture ERS, Agriculture and Trade Report No. WRS013, 2001.

Schuh, G. "The Exchange Rate and U.S. Agriculture." *American Journal of Agricultural Economics*. 56(1974):1-13.

Schuh, G. "The New Macroeconomics of Agriculture." *American Journal of Agricultural Economics*. 58(1976):802-911.

United Nations, Commodity Trade Statistics (COMTRADE). Internet site: http://unstats.un.org/unsd/comtrade (Accessed February 10, 2005).

U.S. Department of Agriculture Foreign Agricultural Service (FAS). Internet site: http://www.fas.usda.gov/oilseeds/circular/2005/05-07/toc.htm (Accessed October 10, 2005).

U.S. Department of Agriculture ERS, Adoption of Genetically Engineered Crops in the U.S. Internet site: http://www.ers.usda.gov/data/biotechcrops (Accessed October 21, 2005).

U.S. Department of Agriculture ERS. *Lower Real Boots Brazil's Agricultural Exports.* International Financial Crises and Agriculture, No. WRS-99-3, 2000.

U.S. Department of Agriculture ERS, Oil Seeds: World Markets and Trade. Internet site: http://www.fas.usda.gov/oilseeds/circular/2005/05-07/toc.htm (Accessed October 21, 2005).

Zellner, A. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias." *Journal of the American Statistical Association.* 57(1962):348-368.

Table 1. Results for Import Demand of Soybeans from the United States and Argentina and Brazil by Major Importing Countries

Variables	Description	Error component three-stage least squares (EC3SLS)	
		United States	Brazil and Argentina
TM	Total soybean imports.	0.94 ** (27.02)[a]	1.70 ** (19.58)
P^j/P^c	Ratio of export prices exporter j and its main competitors.	0.26 ** (5.11)	1.06 ** (8.80)
$XR^{i/j}$	Exchange rate between importers and the United States.	-0.14 ** (-2.93)	0.70 ** (6.37)
$XR^{i/c}$	Exchange rate between importers and Brazil and Argentina.	0.15 ** (3.69)	-0.47 ** (-4.58)
GMS_{t-1}	Lagged percentage of GM soybeans planted in the United States.	-0.04 ** (-3.49)	-----

[a] ** indicate statistical significance at the 1 percent level. Numbers in parenthesis are for the *t* statistic.