The Impacts of Market Power and Exchange Rates on Prices of European Union Soybean Imports

Oluwarotimi Odeh and Hikaru Hanawa Peterson
Department of Agricultural Economics, Kansas State University
342 Waters Hall, Manhattan 66506, Kansas
Contact: oodeh@agecon.ksu.edu

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003

The Impacts of Market Power and Exchange Rates on Prices of European Union Soybean Imports

Abstract

This study examines whether the EU, the world's largest importer, exercises market power over soybean imports. Results, based on 1975-2000 data, suggest that the EU has practiced price discrimination against imports from Argentina and Brazil. The evidence for the practice of pricing-to-market based on exchange rate changes is mixed.

Introduction

The level of competition in the international market for soybean products has consistently generated considerable interest among researchers and stakeholders (governments, producers and investors) worldwide. Earlier studies have shown that the soybean export market, dominated by Argentina, Brazil, and the United States, is perfectly competitive (Pick and Pack, 1991; Larson and Rask, 1992; Deodhar and Sheldon, 1997; Schnepf, Doblman and Bolling, 2001). During the last two decades, the soybean processing industry has become increasingly consolidated, with 70 percent of soybean processing handled by less than ten major firms (Marion and Kim, 1991; Scoppola, 1995). The European Union (EU), which has become the world's largest economic entity, holds discernible shares in both the import and export of soybeans and soybean products.

Since its establishment in 1957 with six members, the EU doubled its membership in 1986 when Spain and Portugal joined. Austria, Finland, and Sweden were granted membership in 1995. The current fifteen members are developed, high-income countries with estimated total Gross Domestic Product of $9.46 billion in 2000, 15 percent higher than that of the U.S. In December 2002, the EU welcomed ten additional countries: Poland, Hungary, the Czech Republic, Slovenia, Slovakia, Latvia, Lithuania, Estonia, Cyprus, and Malta. When the voters of these countries ratify the membership, the EU will consist of 25 countries including half a billion people.

The objective of this study is to determine whether market power is exercised in the world soybeans import market. This is particularly important and relevant because being the world's largest importer of the commodity, the increasing size of the EU could bestow on it considerable power to impact prices in the soybeans market through price discrimination. Past studies on the existence of market power in the global soybean market have been limited to the export market (Heien and Pick, 1991; Pick and Park, 1991; Deodhar and Sheldon, 1997; Schnepf, Doblman and Bolling, 2001), and series of changes have occurred in the soybean market since most of these studies were conducted, including the increasing share of Argentina and Brazil in the soybean export market and the increase in size of the EU.

The recent structure of the global soybean import market is examined using the fixed-effects econometric model and testing Krugman (1987)'s the pricing-to-market hypothesis on annual pooled data from 1975 to 2000. The approach, following Rakotoarisoa and Shapouri (2001), enables us to identify market power, if any, in the soybean import market and to estimate the impact of exchange rate movements on prices. Findings from the study will be useful to present and prospective investors in the soybean market, along with policy makers, researchers and all stakeholders in the import crop market in general.

The next section provides an overview of recent developments in the world soybean market with an emphasis on the exchange rates. This is followed by a review of previous studies on the world soybean market. The model is developed to test the anti-competitive behavior, particularly through practices of pricing-to-market—where trading partners with market power adjust prices in their favor given changes in the exchange rates—and price discrimination, in the world soybean import market. Following the discussion of data sources, empirical results are presented and discussed. We find that the EU has been exercising market power through price

discrimination against Argentina and Brazil. Results of the effects of exchange rates on imports prices were mixed, providing inconclusive evidence of the practice of the pricing-to-market.

The World Soybean and Soybean Products Market

The EU is the world's largest importer of soybeans and soybean meal, with import value shares in 2000 of 31.7 and 46.0 percent, respectively. Other major importers of soybeans are Japan (13 percent), Mexico, and China (8 percent each). At the same time, the EU is the world's second largest exporter of soybean oil with 21 percent share, and produces a considerable amount of soybean meal domestically to make it a net exporter. The EU has been a major trading partner of the three major exporting countries of the world: the U.S., Brazil, and Argentina. With a flat trend in the domestic production, the EU will continue to be a major importer of soybean with potentially increasing impact on the world price (USDA, 2001).

The exchange rate of euro relative to the major exporting countries' currencies affects commodity prices. The euro depreciated from its introduction rate of $1.16 in January 1999 to $0.85 by November 2000. As a large importing country, depreciation of the EU's exchange rate will increase the price of its imports, since the purchasing power of the domestic currency has decreased. Coupled with the strict Common Agricultural Policy, the devaluation of euro has sustained relatively higher domestic prices of agricultural products (particularly soybeans products) within the Union. The exchange rate of the EU currency has been placed under the managed system, where the central bank intervenes to maintain the rate within a fixed range.

The exchange rate situations in major exporting countries have been mixed. In particular, the Argentine currency (peso) has been volatile since the late 1990s. A number of relatively long-standing economic problems in Argentina have converged into an economic crisis by the year 2001. This forced the government to cut off the domestic currency (peso) from its former fixed rate of one-to-one with the U.S. dollar in 1991, which depreciated by over 300 percent in real terms between 1999 and 2002 (Torgerson, 2002). Though the devaluation could potentially

benefit the economy as export is boosted, crop production in the country has declined as capital flight reduced loan access. Recent export taxes on soybeans (currently 23.5 percent) and their products have dampened the prospect of enhanced export (Torgerson, 2002). The exchange rate situations in Brazil and U.S. have however been relatively stable.

While Brazil and Argentina's shares of soybean exports have continued to increase, U.S. exports of soybeans and soybean meal have declined in recent years (Ash, 2002) due to a marginal growth in domestic soybean meal consumption and relative returns favoring crop production shifts towards corn and wheat. U.S. soybean oil exports continue to increase (Ash, 2002).

Previous Studies

Several research efforts have been made in the past with varying focus and results. In estimating the demand structure for soybean and soybean meal applying the Almost Ideal Demand System model to quarterly data between 1976 and 1984, Heien and Pick (1991), found that U.S. was no longer the dominant soybean supplier in the world market, and concluded that the market is competitive. Pick and Park (1991) examined the competitive structure of agricultural exports from the U.S. using the pricing-to-market model, which incorporated an index of exchange rate disparity among countries. Contrary to Heien and Pick (1991), they concluded that the soybean export market was not perfectly competitive with the U.S. as the market leader.

More recently, Deodhar and Sheldon (1997) used the New Empirical Industrial Organization approach to determine whether market power exists in the soybean meal export market. They concluded that the market was perfectly competitive over the 1966 -1993 sample period. Schnepf, Doblman, and Bolling (2001) also found that the soybeans export market is

competitive, with Argentina, Brazil and the U.S. being the major competitors, over the 1990-2000 study period.

In all, previous studies have focused on the export side of the world soybean and soybean products markets and there appears to be a consensus that the export market has been competitive, particularly since the 1990s. However, the competitiveness of the import market has not been addressed. We cannot infer from these previous results on export markets, since the import market is distinct. The dominance of the EU in the global soybean and soybean meal import shares underscores the need to ascertain whether the world soybean import market is also competitive.

Soybean Import Market Model

The pricing-to-market hypothesis (Krugman, 1987) explains a link between prices and exchange rate movements. Trading partners, say exporters, can exercise market power by adjusting prices sold to different markets in their favor when exchange rates defining the terms-of-trades change. Consequently, the transaction prices do not fully reflect the changes in the exchange rates. By testing whether the exchange rate changes are completely passed through to transaction prices, the presence of market power through pricing-to-market practices can be identified.

Knetter (1989) builds the following model to test the exchange-rate pass-through to examine competitiveness in an export market. From the first order condition of the profit maximization problem of the exporter, the export price to market *i* at time *t* can be derived in the exporter's currency as $p_{it} = c_t \left[\varepsilon_{it} \big/ (\varepsilon_{it} - 1) \right]$, where ε_{it} is the price elasticity of demand facing the exporter in market *i* and c_t is the marginal cost. If the market is competitive with no market power intervention, the export price would evolve independent of exchange rate changes. The

exporter with market power may set discriminatory prices across different markets based on price elasticity of demand. Otherwise, the export price should be equal across the markets. Knetter (1989) proposes regressing the export price on the exchange rate between the exporter and importer's currency (*e*), with country-specific effect (λ_i) to capture price discrimination:

(1) $$\ln p_{it} = \theta_t + \lambda_i + \beta_i \ln e_{it} + \mu_{it}$$

where θ_t measures trend in marginal costs, β_i is the parameter for the exchange rate effect, and μ_{it} is the error term. A perfectly competitive market structure corresponds to the case where λ_i and β_i both equal zero. $\beta_i \neq 0$ implies the presence of pricing-to-market practices, and $\lambda_i \neq 0$ implies price discrimination.

Knetter's model has been used to identify the presence of market power and price discrimination in the soybean export market in previous studies (Pick and Park, 1991; Abbort *et al*., 1993; Yumkella *et al.* , 1994; Deodhar and Sheldon, 1997). Rakotoarisoa and Shapouri (2001) applied the model to vanilla importers. We follow their approach to examine the competitiveness of the soybean products market and forms of anti-competitive behavior by the EU.

The profit function of the EU, which imports soybeans from *n* countries and produces soybean meal and oil, at time *t* is:

(2) $$\pi_t = p_t f(q_{it}, L_t, K_t) - \sum_{i=1}^{n} q_{it} r_{it} - w_t L_t - c_t K_t$$

where *p* is the price of output, say soybean oil, q_i represents the quantity of soybeans imported from country *i*, $f(\cdot)$ is the production function, *L* and *K* are labor and capital, r_i is the price of soybeans imported from country *i*, and *w* and *c* are factor prices of labor and capital. The first order condition that maximizes (2) is:

(3) $$p_t \frac{\partial f(\cdot)}{\partial q_i} = r_{it}\left(1+\frac{1}{\eta_{it}}\right)$$

where η_{it} is the price elasticity of import supply faced by the EU. Solving for r_{it} yields:

(4) $$r_{it} = p_t MPP_{it}\left[\frac{\eta_{it}}{\eta_{it}+1}\right]$$

where *MPP* is the marginal physical product of soybeans. Since soybeans are relatively homogeneous, *MPP* should not differ significantly across sources (i.e., $MPP_i = MPP$ for all *i*). If the EU exercises market power through price discrimination based on differences in import supply elasticities, the price paid for soybeans from various sources could differ. If market power is exercised in the form of pricing-to-market, import price movements should reflect the changes in corresponding exchange rates. Thus, Rakotoarisoa and Shapouri (2001) suggest the following regression model to test for the presence of market power in an import market:

(5) $$\ln r_{it} = \theta_t + \lambda_i + \alpha \ln p_t + \beta_i \ln e_{it} + \mu_{it}$$

where, as before, θ_t measures trend in the marginal physical product, λ_i are country-specific terms, β_i is the parameter for the exchange rate effect, μ_{it} is the error term, and α is the parameter for the output price.

A non-zero relationship between the exchange rates and import prices ($\beta \neq 0$) suggests an incomplete exchange rate pass through, where the EU is exercising market power towards their suppliers. If the EU practices price discrimination across their suppliers, we expect country-specific terms to be different from zero ($\lambda_i \neq 0$). The parameter on the output price is expected to be positive, given the first-order condition.

In addition, import prices may be affected by the changes in the EU during the period of analysis. The EU has grown in 1986—when Spain and Portugal joined—and 1995—when

Austria, Finland, and Sweden joined. Moreover, euro was fully adopted in 1999. These changes may affect the import prices through changes in soybean production technology within the Union or market power, and are therefore included in the estimated model.

Data

Quantity and value data spanning from 1975 through 2000 on soybeans, soybean meal and soybean oil imports (by EU-15) and exports (from U.S., Brazil and Argentina) were collected from the Food and Agriculture Organization. From these, unit values for the different products were computed as import price proxies. Nominal and real exchange rate figures on the three exporting countries and the EU-15 for the same period were obtained from the U.S. Department of Agriculture (USDA). Also, the consumer price index for the EU-15 (USDA) was used to deflate the nominal prices into 2000 euro terms.

To account for the changes in the size of the EU, two dummy variables are introduced. The first (*D1*) equals one from 1986 through 2000 and zero otherwise, while the second (*D2*) equals one from 1995 through 2000 and zero otherwise. To capture the impact of full adoption of the EU euro, a binary variable *EURO* is specified to equal one for 1999 and 2000, and zero otherwise. The U.S. is specified as the base of country-specific effects. Soybean meal and soybean oil were separately considered as outputs of soybeans, and the model was estimated using the nominal and real exchange rates and price series, respectively.

Prior to the estimation, correlation between import prices from Brazil and Argentina and autocorrelation were detected in the data. Thus, the model is estimated by the Park's method using the PROC TSCSREG program in SAS, which corrects for heteroskedasticity, first order autocorrelation, and contemporaneous correlation to yield consistent parameter estimates in panel data analysis. Although the Park's method has been reported to underestimate the standard

error covariances when compared to ordinary least squares when the number of cross sectional units is close to the number of observations of the cross sectional units, the period considered in the study is sufficiently long to annul this effect.

Results

Table 1 shows the results based on the nominal exchange rates and nominal prices, for the cases where soybean meal and oil are considered as the output, respectively. Country effects are statistically significant in both cases, suggesting that the EU has discriminated against soybean imports from Argentina and Brazil relative to the counterparts from the U.S. Perhaps there may be a difference in product or service quality (e.g., transportation, payment methods) that is beyond the scope of the present study. Otherwise, the results suggest that import supply from Argentina and Brazil are more inelastic than the U.S. The effects of the exchange rate are statistically not different from zero, implying that the exchange rate pass through is complete on average. Thus, the EU exercises market power in the soybean import market through price discrimination but not through pricing-to-market practices.

In line with *a priori* expectation, the output effects are positive and statistically significant. The output price estimates indicate that a one percent increase in soybean meal and soybean oil prices causes the imported soybean price to increase by 0.75 percent and 0.68 percent, respectively. In the soybean oil case, the trend effect is statistically significant, suggesting that marginal physical product of soybean has increased over the sample period due to improved milling technology. The full adoption of euro in 1999 did not have a statistically significant impact on the import price. The changes in the size of the EU, however, are estimated to have impacted soybean import prices. Particularly, it is estimated that the size change in 1986 significantly lowered the import prices. The size change in 1995 had no

significant impact on soybean imports, likely because Finland, Austria, and Sweden are not major soybean importers.

The regression results with real price and exchange rates are presented in Table 2. A major change from the results based on nominal series is that the exchange rate effects are estimated to be statistically significant in the case using soybean meal. The results imply that a one percent devaluation of the Argentine peso, Brazilian real and the U.S. dollars, ceteris paribus, results in 0.241, 0.244, and 0.237 percent reduction in the euro import price of the soybeans, respectively. This implies that about 0.76 percent of the one percent devaluation is passed through to prices denominated in the local currencies of the exporting countries. The similar results for Brazil and Argentina may partially be accounted for by the correlation between the exchange rates of the two countries, besides comparable market share and prices due to geographic proximity and production technologies.

Morever, larger country effects are estimated for the soybean oil model with real price series. Our results consistently suggest the EU's price discrimination against Argentina and Brazil soybean imports relative to the U.S. The signs and magnitudes of the estimated trend effect, output price effect, and the effect of EU's size changes remain similar to those based on the nominal series. The change in the EU membership in 1986 apparently depressed the import price.

As noted by Rakotorisoa and Shapouri (2001), it is important to note that unlike the model which aggregates trading activities to national levels, individual firms in practice dominate the soybean market, and our results should be interpreted with caution. This is particularly worth emphasizing because exchange rate adjustments may not be specific to commodity price movements as assumed in the model.

Concluding Remarks

This paper studies the recent international soybeans market and examines the effects of exchange rate movements on prices of soybeans imported by the EU from the three major exporting countries. The fixed effects econometric model was applied to investigate the presence of the EU's market power exercised through pricing-to-market practices and price discrimination in the world soybean import market.

Results show the existence of price discrimination in the import market against Argentina and Brazil, relative to the U.S. This confirms that the soybean import market structure is not competitive, contrary to the recent findings of competitiveness in the export market. The evidence of pricing-to-market practices was mixed. The nominal exchange rate effects were not significant for both soybean meal and oil, while the real exchange rate effects were significant for the soybean meal. The introduction of the euro may relatively be too new to make any appreciable impact in this respect. Another revelation of the study is that the size of the EU seems to have a depressing effect on the soybean import price. This suggests that appreciable impact could be expected in the future, with the approved membership of ten countries

It is important to note that while this study has laid a solid foundation for further study of the soybeans import market, policy implications of our results require a better understanding of the intricacies of the market. Since the EU has become the largest trading bloc in the world, its trade and agricultural policies impact price determination in multiple global markets. Any anti-competitive behavior is bound to elicit retaliatory actions from other trading parties, particularly those with substantial bargaining powers like the U.S. Future studies could also examine how the present findings might change if Japan, the world's second largest importer of soybeans, is incorporated into the model in a duopsony setting.

References

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

Ash, M. "Strong Competition and Rising Prices Confront U. S. Soybean Exports." *ERS/USDA commodity spotlight report* (2002).

Deodhar, S. , and I. Sheldon. "Market Power in the World Market for Soymeal Exports." *Journal of Agriculture and Resource Economics* 22 (1997): 78-86.

FAO: http://apps. fao. org/page/collection=Trade

Heien, D., and D. Pick. 'The Structure of International Demand for Soybean products." *Southern Agricultural Economics Association* 23 (July 1991): 137-143.

Knetter, P. R. "Price Discrimination by U. S. and German exporters". *American Econ. Rev*. 79 (1989): 198-210.

Krugman, P. "Pricing to Market when the Exchange rate changes." *Real-financial linkages Among open Economies*, ed. S. W. Arndt and J. D. Richardson. Cambridge MA: MIT Press, 1987.

Larson, D. W., and N. Rask. "Industry Note: Changing Competitiveness in World Soybean Markets." *Agribusiness* (1992):79-91.

Marion, B. W., and D. Kim. "Concentration Change in Selected Food Manufacturing Industries: The Influence of Mergers vs. Internal Growth. " *Agribusiness* 7(1991): 415-31.

Pack, R. "Efficient Estimation of a System of Regression Equation when Disturbances are both Serially and Contemporaneously Correlated." J. Am. Statistics Assoc. 62 (1967): 500-509.

Pick, D. and T. Park. "The Competitive structure of U.S. Agricultural Exports." *American Journal of Agricultural Economics* 73 (1991): 131-141.

Rakotorisoa, M. A, and Shapouri, S. "Market Power and the Pricing of Commodities Imported from Developing Countries; The Case of U. S. Vanilla Bean Imports". *Agricultural Econonmics* 25 (2001): 285-294

Reed, M. R. *International Trade in Agricultural Products*. Prentice-Hall Inc. New Jersey, 2001.

Schnepf, R. , E. Doblman, and C. Bolling. "Agriculture in Brazil and Argentina: Developments and Prospects for major field crops." *ERS Agriculture and Trade Report* No. WRS013 (2001).

Scoppola, M. “Multinationals and Agricultural Policy in the EC and USA.” *Food Policy* 20 (1995): 11-25.

Torgerson, D. “Argentina’s Economic Crisis: Can the Ag Sector Help?” *An ers/USDA special article* (2002).

USDA: http://www. ers. usda. gov/publications/wrs013/wrs013. pdf

USDA: http://www. ers. usda. gov/briefing/baseline/gtrade. htm

USDA: http://www.ers.usda.gov/Data/exchangerates/NominalAnnualcountryExchangeRates.xls

USDA: http://www.ers.usda.gov/Data/exchangerates/RealAnnualcountryExchangeRates.xls

Yumkella, K. K., L. J. Unnevehr, and P. Garcia. “Non-Competitive Pricing and Exchange Rate Pass-Through in Selected U. S. A and Thai Rice Markets.” *Journal of Agric. App. Econ*. 26 (1994): 406-416.

Table 1 Regression Results Using Nominal Prices and Exchange Rates (Dependent variable is soybean import price; output considered is (a) soybean meal and (b) soybean oil)

Intercept	Trend Effect	Country effect	Exchange rate effect	EU size effect	Output price effect	euro effect
(a) Soybean meal [R^2= 0. 64]			Nominal			
-0. 387*	-0. 006				0. 685*	-0. 012
(0. 120)	(0. 004)				(0. 077)	(0. 060)
Arg		-0. 064*	-0. 002			
		(0. 024)	(0. 002)			
Bra		-0. 027**	-0. 000			
		(0. 014)	(0. 001)			
USA			0. 014			
			(0. 042)			
D1				-0.157*		
				(0. 047)		
D2				0. 009		
				(0. 040)		
(b) Soybean oil [R^2= 0. 64]						
-0. 3166	0. 007**				0. 753*	0. 012
(0. 133)	(0. 004)				(0. 090)	(0. 067)
Arg		-0. 066*	-0. 002			
		(0. 024)	(0. 002)			
Bra		-0. 029**	-0. 001			
		(0. 013)	(0. 001)			
USA			0. 004			
			(0. 039)			
D1				-0. 197*		
				(0. 047)		
D2				0. 017		
				(0. 040)		

Note : * indicates significance at 1% level.
** indicates significance at 5% level.
*** indicates significance at 10% level.
Figures in parenthesis are standard errors.

Table 2 Regression Results Using Real Prices and Exchange Rates (Dependent variable is soybean import price; output considered is (a) soybean meal and (b) soybean oil)

Intercept	Trend Effect	country effect	Exchange rate effect	EU change effect	Output price effect	euro effect .
(a) Soybean meal [R^2= 0. 97]			Nominal			
-0.174**	-0.001				0.742*	0.024
(0.086)	(0.006)				(0.091)	(0.063)
Arg		-0.043**	0.241**			
		(0.022)	(0.102)			
Bra		-0.020**	0.244**			
		(0.010)	(0.092)			
USA			0.237**			
			(0.097)			
D1				-0.183*		
				(0.052)		
D2				0.029		
				(0.045)		
(b) Soybean oil [R^2= 0. 98]						
0.008	0.006				1.005*	-0.041
(0.045)	(0.004)				(0.060)	(0.042)
Arg		-0.177*	-0.029			
		(0.032)	(0.059)			
Bra		-0.168*	-0.005			
		(0.028)	(0.056)			
USA			0.024			
			(0.078)			
D1				-0.107**		
				(0.045)		
D2				-0.017		
				(0.038)		

Note : * indicates significance at 1% level.
** indicates significance at 5% level.
*** indicates significance at 10% level.
Figures in parenthesis are standard errors.