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Linking of U.S. monetary policy and exchange rates to world soybean markets

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ABSTRACT

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The linkage between macroeconomic policies and agricultural commodity trade has become an important research issue of agricultural economists. This paper investigates the macroeconomic linkage of soybean trade competition between the exporting countries of the United States, Brazil, and Argentina in the EC-12 and Japan import markets. It is argued that U.S. monetary growth may have important impacts on the competitive position of U.S. soybean exports through exchange rates. Two relationships are investigated: (a) the effects of U.S. monetary growth on the agricultural trade weighted exchange rates, and (b) the responsiveness of agricultural commodity prices and U.S. exports to exchange rate movements. Results indicate that a weak dollar increases imports of soybeans and soymeal significantly which serves to increase the equilibrium world price and increase both U.S. and Brazil/Argentina exports in the long run. However, during periods of more expansionary U.S. monetary policy there is little evidence of significant increases in market share position for U.S. soybeans and soymeal in world markets.

INTRODUCTION

The linkage between macroeconomic policies and agricultural commodity trade has become an important research issue of agricultural economists. The seminal paper by Schuh (1974) called attention to the importance of

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an over-valued exchange rate on U.S. farm exports and on the adjustment problems of U.S. agriculture. His work stimulated the interest of agricultural economists to study exchange rate and agricultural trade issues (Kost, 1976; Bredahl and Gallagher, 1977; Johnson et al., 1977; Chambers and Just, 1981, 1982; Haley and Krissoff, 1986; Jabara and Schwartz, 1987; Paarlberg and Chambers, 1988). Since many issues are addressed in the exchange rate debate, this review is limited to studies of the effects of U.S. monetary policy on the volatility of agricultural commodity prices and export trade. In this debate the linkage between two structural relationships is paramount: (a) the effects of U.S. monetary growth on the agricultural commodity trade-weighted exchange rate, and (b) the responsiveness of agricultural commodity prices and U.S. exports to exchange rate movements.

Much of the current empirical work in this area has focused on one or the other of these two relationships. In the first case, Batten and Belongia (1983, 1986) provide evidence of a low correlation coefficient between the real trade-weighted exchange rate and U.S. monetary growth in the long run. In the second case, Jabara and Schwartz (1987) conclude that an asymmetry exists in exchange rate pass-through for agricultural commodities traded with Japan during the early 1980's.

Additional studies provide evidence of a significant link between real exchange rates and agricultural prices and exports (Chambers and Just, 1981; Longmire and Morey, 1983; Batten and Belongia, 1986; Haley and Krissoff, 1986). Batten and Belongia (1983) suggest that the effects of income changes in importing countries dominate that of the real exchange rate on U.S. agricultural exports. Collins et al. (1980) conclude that exchange rate movements have little effect on the variability of real commodity prices.

Research that links the two relationships together is reported by Chambers and Just (1982) and Batten and Belongia (1986). Chambers and Just (1982) conclude that U.S. farm export performance is closely linked to U.S. money supply. Their conclusion is based on analysis that used the International Monetary Fund special drawing rights (SDR) exchange rate per U.S. dollar as the effective exchange rate for all commodities. This is in contrast to the more traditional approach of using trade weighted exchange rates. Alternatively, Batten and Belongia (1986) conclude that there is a low correlation between the real trade-weighted exchange rate and U.S. monetary growth.

This paper investigates the effects of U.S. monetary growth on U.S. export competition with Brazil and Argentina through trade-weighted exchange rates in the world soybean market. A monetary approach to the determination of the exchange rate is adopted as the basis for analysis. A trade-competition model is developed to explore the existing soybean structure in the world market. Finally, the elasticities of world prices, exports, and imports with respect to U.S. monetary growth are formulated and calculated.

BACKGROUND ON WORLD SOYBEAN TRADE

Exports comprise an important component of U.S. farm income for soybeans. The real value of U.S. soybean exports increased from 14.6% of total agriculatural exports in the 1960's to 22.5% in the 1970's. Between 1980 and 1985, the share of U.S. soybean exports to agricultural exports was about 20%.

Major export competitors of the U.S. in world soybean markets are Brazil and Argentina. Brazil and Argentina increased soybean and soymeal exports significantly in the early 1970's (Table 1). Since the early 1970's, U.S. exports of soybeans and soymeal have faced increasing competition from Brazil and Argentina. The only exception to this increasing competitive pressure occurred during the Brazilian drought years of 1978 and 1979. The decreased Brazil/Argentina world soybean and soymeal market shares between 1981 and 1983 were the result of their domestic production shortfall. As a result, the U.S. soybean export share in the world market increased. However, during this same period the U.S. soymeal export share

TABLE 1

Export shares of soybeans and by-products: U.S., Brazil, Argentina, and Rest of World (ROW), marketing year, selected years 1965–1985 (%)

Year	Soybean exports			Soymeal exports			Soyoil exports		
	U.S.	Brazil and Argentina	Row	U.S.	Brazil and Argentina	Row	U.S.	Brazil and Argentina	ROW
1965	88.2	1.2	10.7	65.4	3.7	30.9	78.1	0.0	22.0
1970	93.7	2.3	4.0	63.9	10.1	26.0	58.2	0.3	41.6
1975	73.5	22.6	3.9	40.4	37.4	22.2	30.2	22.0	47.8
1980	82.0	14.7	3.4	38.2	38.3	23.6	34.6	25.4	40.1
1981	80.3	15.1	4.61	31.0	46.0	23.0	21.6	37.8	40.6
1982	85.6	10.0	4.5	30.2	43.6	26.2	25.9	30.1	44.0
1983	86.4	9.3	4.3	27.7	41.9	30.3	24.4	33.1	42.6
1984	76.9	18.0	5.2	22.2	47.2	30.6	20.8	35.8	43.4
1985	65.4	25.8	8.8	20.1	50.6	29.3	20.7	40.5	38.9

Source: U.S. Department of Agriculture, Fats and Oil Situation, various issues. Washington, DC.

TABLE 2

Export shares of U.S. Brazil and Argentina in the EC-12 and Japan market (%)

Year	Soybeans		Soymeal		Soyoil	
	U.S.	Brazil and Argentina	U.S.	Brazil and Argentina	U.S.	Brazil and Argentina
1965	98.4	1.6	93.4	6.6	na	na
1966	97.8	2.2	90.7	9.4	na	na
1967	95.1	4.9	93.6	6.4	na	na
1968	99.0	1.0	89.9	10.1	na	na
1969	95.3	4.7	87.9	12.1	na	na
1970	96.8	3.2	81.7	18.3	77.4	22.6
1971	97.7	2.3	75.2	24.8	44.0	56.0
1972	80.3	9.7	63.1	36.9	1.7	98.3
1973	85.3	14.7	68.9	31.1	10.7	89.3
1974	79.8	20.2	58.5	41.5	48.0	52.0
1975	75.0	25.0	43.1	56.9	3.3	96.7
1976	76.2	23.8	43.1	56.9	2.3	97.7
1977	79.7	20.3	31.9	68.1	1.2	98.8
1978	85.2	14.8	38.7	61.3	1.8	98.2
1979	80.7	19.3	39.0	61.0	1.0	99.0
1980	79.0	21.0	36.5	63.5	0.0	100.0
1981	82.6	17.4	29.5	70.5	1.9	98.1
1982	89.1	10.9	31.3	68.7	2.8	97.2
1983	85.4	14.6	29.5	70.5	0.3	99.7
1984	74.0	26.0	14.9	85.1	0.3	99.7
1985	64.9	35.1	15.7	84.3	0.2	99.9

Source: U.S. Department of Agriculture and Foreign Argricultural Trade of the U.S.
na represents data not available.
Brazil/Argentina data are proxies.

declined. This was due to rising export levels from countries other than the U.S., Brazil, or Argentina.

United States, Brazil, and Argentina soybean export shares to the European Community (EC-12) and the Japan market are listed in Table 2. The EC-12 and Japan are major importers of soybeans and soybean products. These countries produce only a small amount of soybeans and have to import soybeans and/or soybean products for domestic needs. Since 1971, Brazil and Argentina have increased their soybean export share to the EC-12/Japan market with the exception of the sporadic production difficulties during the period 1978 through 1983. By 1984 their soybean export share had recovered to the trend observed in the 1970's. Since the late 1960's, Brazil and Argentina have increased their market share of soymeal exports to EC-12 and Japan relative to the United States.

There are two distinct trends in U.S. soybean and soymeal export shares to the EC-12/Japan market in competition with Brazil and Argentina exports. First, U.S. soybean export shares began a steady decline from 1972 through 1977 after capturing a minimum of 95% of the market during the period 1965 through 1971. U.S. market share recovered somewhat during the period 1978 through 1983 and then declined sharply in 1984. Second, with some exceptions, the U.S. soymeal export share has declined steadily over the period 1965 through 1985.

During the period 1965 through 1985, U.S. monetary policy underwent a change from more expansionary to a less expansionary rate of growth. While a precise point of departure in monetary policy is difficult to identify it is generally accepted that this shift was initiated in 1979–80. The period of less expansionary monetary policy after 1979–80 coincides with a rapidly rising value of the U.S. dollar relative to other major currencies. As a result, there appears to be a linkage between monetary policy, exchange rates, and the level of U.S. soybean and soybean product export shares to the EC-12/Japan market.

A MONETARY-TRADE COMPETITION MODEL

The theory of the monetary approach to exchange rate determination developed by Frenkel (1976) and Mussa (1976) serves as the point of departure for this study. The underlying arguments are that as the U.S. increases (decreases) the growth rate of money supply, domestic nominal and real interest rates will decrease (increase), which encourages capital outflow (inflow) and the U.S. dollar becomes weaker (stronger). Foreign countries may pursue an exchange rate intervention policy in response to rates of domestic inflation that differ dramatically caused by their own internal monetary policies. Thus, the determination of the bilateral exchange rate depends on both U.S. and foreign money market equilibrium.

In fact, Brazil and Argentina follow a policy of devaluing their currency against the U.S. dollar over time to maintain the purchasing power parity (PPP) and their competitive position of exports (Williams and Thompson, 1984b). Members of the EC-12 may attempt to neutralize U.S. monetary policy as it affects the dollar exchange rate. Therefore, the effects of U.S. monetary growth on the Brazil/Argentina and EC-12/Japan exchange rates should be different.

The equilibrium price and quantity are determined by the relative elasticities of exports and imports with respect to the exchange rate and world price. This suggests that a simple export demand equation will not be appropriate to estimate the competitive position of U.S. exports in the world market. A three-country monetary trade competition model is adopted.

Using the one-bond, one-good, and flexible-price assumptions, the exchange rate determination equation can be derived. The one-bond assumption implies perfect substitution between domestic and foreign bonds. The exchange rate determination is then shifted to the money markets. The domestic and foreign money market equilibrium conditions and the purchasing power parity can be expressed as:

– money market equilibrium in the U.S.

$$\ln \text{MS} = \ln p + \phi \ln y - \tau \ln i \tag{1}$$

– money market equilibrium in the other country

$$\ln \text{MS}^* = \ln p^* + \phi \ln y^* - \tau \ln i^* \tag{2}$$

– the purchasing power parity condition

$$\ln e_j = \ln p^* - \ln p \tag{3}$$

All variables are defined such that MS is the nominal domestic money supply, p is the domestic price level, y is domestic real income, and i is the domestic short-term interest rate. The superscript * refers to the foreign country. The exchange rate (e_j) is the amount of jth foreign currency per U.S. dollar. The parameters ϕ and τ are domestic and foreign money demand elasticities. It is assumed that the money demand elasticities are equal for both the domestic and foreign markets.

As all variables are logarithms the (ln) notation will not be explicitly stated in the following derivations. Solving equations (1) to (3) for the exchange rate, the equilibrium exchange rate equation can be written as:

$$\hat{e}_j = (\text{MS}^* - \text{MS}) - \phi(y^* - y) + \tau(i^* - i) \tag{4}$$

A higher level of U.S. money supply to foreign money supply lowers the exchange rate and thereby depreciates the U.S. dollar, ceteris paribus. The sign of ($\text{MS}^* - \text{MS}$) is expected to be positive. A relatively higher U.S. income level compared to that of a foreign country will increase the exchange rate and appreciate the U.S. dollar. Finally a higher relative level of the U.S. interest rate to that of a foreign country decreases the domestic demand for U.S. assets (money), lowers the exchange rate, and depreciates the value of U.S. dollar.

Under the one-bond assumption, the relative level in the foreign to domestic interest rate can be expressed as the expected rate of change in the spot market exchange rate:

$$i^* - i = \text{E}(\Delta e) \tag{5}$$

where E and Δ are signs of expectation and change, respectively. This expected rate of change is a result of a difference in the expected inflation rates:

$$\mathrm{E}(\Delta e) = \mathrm{E}(\Delta p^*) - \mathrm{E}(\Delta p) \tag{6}$$

It is assumed that there is a long-run secular inflation which may affect the money demand function and the expected appreciation of the domestic currency. The adjustment of the expected change in the exchange rate can also be expressed as:

$$\mathrm{E}(\Delta e) = -\theta(e - \hat{e}) + [\mathrm{E}(\Delta p^*) - r\ \mathrm{E}(\Delta p)] \tag{7}$$

where θ is the adjustment speed, and $\hat{e}$ is the long-run equilibrium exchange rate.

Combining equations (5), (6), and (7), the deviation of the exchange rate from its equilibrium level can be expressed as:

$$e_i = \hat{e}_i - (1/\theta)[(i^* - \mathrm{E}\ \Delta p^*) - (i - \mathrm{E}\ \Delta p)] \tag{8}$$

Substituting equations (4) and (6) into equation (8) an expression for the current period or spot market exchange rate can be obtained. The general monetary equation of the spot market exchange rate determination becomes:

$$\begin{aligned} e_j = {} & (m^* - m) - \phi(y^* - y) - (1/\theta)(1^* - i) \\ & + (\tau - 1/\theta)(\mathrm{E}\ \Delta p^* - \mathrm{E}\ \Delta p) \end{aligned} \tag{9}$$

Equation (9) becomes the basis to link the effects of U.S. money supply on the exchange rates to the effects of U.S. monetary growth on the exchange rates. The conversion formula between the elasticity of the exchange rate with respect to U.S. monetary growth and that with respect to U.S. money supply is derived in Appendix A.

The exchange rate model is linked to world prices and quantities by extending the trade competition model of Haley and Krissoff (1986) to incorporate Brazil and Argentina as export-competing countries and the EC-12 and Japan as the importing country in the world market for soybean products:

- aggregate U.S. exports to EC-12 and Japan

$$\mathrm{USXP} = \mathrm{ES}^{\mathrm{A}}(\mathrm{WP}/\mathrm{CPI}_{\mathrm{a}}, \mathrm{CAP}_a, Z_{\mathrm{a}}) \tag{10}$$

- aggregate Brazil/Argentina exports to EC-12 and Japan

$$\mathrm{BAXP} = \mathrm{ES}^{\mathrm{B}}(e_{\mathrm{b}}\ \mathrm{WP}/\mathrm{CPI}_{\mathrm{b}}, \mathrm{CAP}_{\mathrm{b}}, Z_{\mathrm{b}}) \tag{11}$$

– aggregate EC-12/Japan imports from the two exporting countries

$$\text{EJMP} = \text{ED}\left(e_j \ \text{WP}/\text{CPI}_j, Z_j\right) \tag{12}$$

– total exports of the U.S., Brazil, and Argentina

$$\text{TXP} = \text{USXP} + \text{BAXP} \tag{13}$$

– the market equilibrium condition

$$\text{TXP} = \text{EJMP} \tag{14}$$

where the nominal world price (WP) is the U.S. dollar import price per metric tonne at Rotterdam for soybeans, at Decatur, Illinois for soymeal, and at reporting European ports for soybean oil. U.S. soybean export capacity is defined as the total domestic supply over domestic demand and is represented by CAP_a. Total domestic supply is the sum of domestic production and carry-over stocks. Crushed soybeans are used as soybean demand for domestic crushing and the quantity of domestic use is adopted as domestic demand for soymeal and oil. As the export capacity increases because of increased domestic production of soybeans or decreased domestic demand for crushing, U.S. excess supply to the world market will increase. The variables Z_a, Z_b and Z_j represent vectors of other exogenous variables such as policy variables, real income levels, and competing product prices.

The nominal exchange rates e_b and e_j express the currency price of Brazil/Argentina and EC-12/Japan relative to the U.S. dollar. The definition of the soybean export capacity of Brazil and Argentina is the same as that of the U.S. and is represented by CAP_b.

TRADE ELASTICITIES

The effects of U.S. monetary policy on the world price and the quantity of U.S. soybean exports can be calculated in elasticity form (Chambers and Just, 1981). In this model the extension to two exporters and an import country makes the algebra a bit tedious but by combining the exchange rate equation (9) with the trade model equations (10) through (14) the elasticity of excess supply for each exporting country and excess demand for the importing country can be derived. The final elasticity expressions are derived by totally differentiating the excess supply and demand equations (10), (11), and (12), and the equilibrium equation (13) with respect to the U.S. money supply m. Multiplying each of the total differentials through by the respective ratios of excess supply and demand to U.S. money supply results in the appropriate elasticity formulations. These are then solved for the elasticities of world price and excess U.S. supply with respect to the U.S. money supply.

The elasticity of the world price with respect to U.S. money supply becomes:

$$\eta_m^{\mathrm{WP}} = \frac{S_{\mathrm{a}}\eta_{\mathrm{WP}^{*\mathrm{a}}}^{\mathrm{ES}^{\mathrm{a}}}\eta_m^{1/\mathrm{CPI}_{\mathrm{a}}} + S_{\mathrm{b}}\eta_{e_{\mathrm{b}}\mathrm{WP}^{*\mathrm{b}}}^{\mathrm{ES}^{\mathrm{b}}}\eta_m^{e_{\mathrm{b}}} - \eta_{e_{\mathrm{j}}\mathrm{WP}^{*}}^{\mathrm{ED}}d^{\mathrm{j}}\eta_m^{e_{\mathrm{j}}}}{\eta_{e_{\mathrm{j}}\mathrm{WP}^{*j}} - S_{\mathrm{a}}\eta_{\mathrm{WP}^{*\mathrm{a}}}^{\mathrm{ES}^{\mathrm{a}}} - S_{\mathrm{b}}\eta_{e_{\mathrm{b}}\mathrm{WP}^{*\mathrm{b}}}} \tag{15}$$

The elasticity of U.S. soybean exports with respect to money supply becomes:

$$\eta_m^{\mathrm{ES}^{\mathrm{a}}} = \frac{\eta_{e_{\mathrm{j}}\mathrm{WP}^{\mathrm{j}}}^{\mathrm{ED}}(\eta_m^{e_{\mathrm{j}}} + \eta_m^{\mathrm{WP}}) - S_{\mathrm{b}}\eta_{e_{\mathrm{b}}\mathrm{WP}^{*\mathrm{b}}}^{\mathrm{ES}^{\mathrm{b}}}(\eta_m^{e_{\mathrm{b}}} + \eta_m^{\mathrm{WP}})}{S_{\mathrm{a}}} \tag{16}$$

where η_j^i represents the elasticity of variable i with respect to variable j. The U.S. monetary growth rate is represented by m. S_{a} and S_{b} are the shares of U.S., Brazil and Argentina soybean exports, respectively. $\mathrm{WP}^{*\mathrm{a}}$, $\mathrm{WP}^{*\mathrm{b}}$, and $\mathrm{WP}^{*\mathrm{j}}$ represent the deflated world market price for the United States, Brazil/Argentina, and EC-12/Japan, respectively. the sign of the calculated elasticity (15) depends upon the magnitudes of the relevant trade elasticities on the right hand side of (15) which must be determined empirically. The sign of the calculated elasticity (16) depends on the relative magnitudes of the elasticities of the world price and exchange rates with respect to U.S. monetary growth. This must also be determined empirically.

MODEL IMPLICATIONS

If the U.S. increases the rate of expansion of the money supply to lower the value of the dollar, this may increase U.S. export competition with Brazil and Argentina. As the U.S. dollar becomes weaker relative to the currency of an importing country, that country may increase imports. However, offsetting currency devaluations by Brazil and Argentina maintain or increase the current exchange rates and lessen the impact of U.S. monetary policy via the exchange rates. As the devaluation occurs, the soybean exports of Brazil and Argentina may retain some of their competitiveness with U.S. exports. The world price may be decreased or increased depending on the relative magnitude among the exchange rate and price effects of exports and imports. The level of exports of exporting countries will depend on the relative magnitude among the exchange rate and price effects of export competing and importing countries.

Similarly, the effects of a tight U.S. monetary policy on the equilibrium price and trade are complex. Brazil and Argentina may not need to devalue their currency to increase their competitive position in the world soybean market. As the world price increases, EC-12 and Japan decrease soybean imports if the exchange rate adjustment does not offset the increased world price. Again, the effects on equilibrium price and quantity depend on the elasticities of soybean exports and imports with respect to local currency price.

DATA

The exchange rates and macroeconomic data are obtained from the International Financial Statistics (IFS). The other data are obtained from the Fats & Oil Situation Reports, and the Foreign Agricultural Service, U.S. Department of Agriculture. The data representing foreign countries' variables are calculated by weighting the index of the same variable X (1980 = 100) in each country with its trade share, i.e. $\Sigma_i\, w_i X_i$. Subscript i denotes the ith country, and w is the import share of the ith country from the U.S. or export shares between Brazil and Argentina. Data used in the trade model are on an annual basis for the period 1965–85. Data for the exchange rate models are on a annual basis over the period 1972 to 1985, when the U.S. flexible exchange rate system was operative.

The exchange rate variables for soybeans and soymeal are calculated by using trade share weights for soybeans or soybean meal in the import country, EC-12/Japan, and the export countries, United States and Brazil/Argentina. Thus, the exchange rate for each country reflects that country's share of total trade. Published data for the soybean oil market are available but the accuracy of these data are questionable due to significant differences in reported data series. For this reason, a trade-weighted exchange rate equation for the soybean oil market is not reported. Income levels in all countries are measured in real terms.

Ordinary least squares is applied to estimate the log-linear trade-weighted exchange rate equations for soybeans and soymeal markets. Seemingly unrelated regression method is used to estimate the trade model equations.

STATISTICAL RESULTS

Exchange rate equations

In the Brazil/Argentina trade-weighted exchange rate equations, the variables $(m^* - m)$ and $(y^* - y)$, and $(\mathrm{E}\ \Delta p^* - \mathrm{E}\ \Delta p)$ are highly collinear. Because of this collinearity, the general exchange rate model was specified by using the actual levels of real income and anticipated price changes.

This specification assumes that there are different response elasticities of money markets with respect to domestic real income level and expected inflation in the relative countries. The estimated coefficients are presented in Table 3.

U.S. money supply has positive and negative effects on the exchange rate faced by importers and competing exporters, respectively. The magnitude of the effect of U.S. money supply on the exchange rate of EC-12 and Japan is much greater than on the exchange rate of Brazil and Argentina. Using the estimated coefficients on money supply (m^* and m) from Table 3 and the derivation in Appendix A, the soybean and soymeal elasticities of the trade-weighted exchange rates with respect to U.S. monetary growth are negative in sign for EC-12 and Japan (-1.28 and -1.36, respectively), and positive in sign for Brazil/Argentina (0.513 and 0.51, respectively). As U.S. monetary growth increases, the trade value of the dollar decreases in the EC-12/Japan exchange market and increases in the Brazil/Argentina exchange market. This suggests that U.S. monetary intervention serves to lower the EC-12/Japan exchange rate but not the Brazil/Argentina exchange rate.

Estimated trade equations

The trade-competition model is estimated empirically by using annual data from 1965 to 1985 for soybeans and soymeal. The results are presented in Table 4.

Soybean export and import equations. In the world soybean market, the estimated coefficient for real world price is positive in sign for U.S. soybean exports. The coefficient on export capacity (CAP) is statistically insignificant. The implication of this is that export capacity, defined as the relative level of total domestic supply to domestic use, is not a constraint for U.S. exports of soybeans.

In Brazil and Argentina, the world soybean price in real local currency is positively related to their exports of soybeans as is evident from the statistically significant positive coefficient for world price (WP). As the U.S. dollar appreciates, Brazil and Argentina increase their competitiveness relative to U.S. soybean exports. The Brazil/Argentina export capacity is positively related to its soybean exports. As the soybean crushing industry grows, domestic demand for soybeans is increased. As a result, the export capacity decreases and the exports of soybeans decline which is consistent with the research of Williams and Thompson (1984a) on the Brazilian soybean industry.

TABLE 3

Estimated exchange rate equations, 1972–1985

Products countries	Constant	$(m^* - m)$	y^*	y	$(i^* - i)$	E Δp^*	E Δp	R^2	d.f.	D−W
I. Soybeans										
a. EC-12 and	−19.752	−2.950 **	3.249 *	0.671	−0.004	0.062 **	−0.021 *	0.83	7	2.13
Japan	(−2.68)	(−4.09)	(1.65)	(0.39)	(−1.33)	(3.16)	(−1.43)			
b. Brazil and	6.729	1.182 **	0.051	–	–	–	−0.041 *	0.996	10	1.68
Argentina	(17.20)	(37.15)	(0.43)				(−1.67)			
II. Soymeal										
a. EC-12 and	−38.396	−3.133 *	–	4.839 **	−0.004	0.085 **	−0.018	0.80	8	1.77
Japan	(−3.80)	(−3.57)		(4.36)	(−1.11)	(2.64)	(−0.76)			
b. Brazil and	7.402	1.174 **	−0.137	–	–	–	−0.039 *	0.996	10	0.95
Argentina	(14.98)	(39.94)	(−0.95)				(−1.74)			

The dependent variable is the log of foreign currency/dollar. The variables are in logarithm forms except the interest rates and inflation rates. The variables are defined as: m^*, EC-12/Japan or Brazil/Argentina level of money supply (M1), IFS; m, U.S. level of money supply (M1), IFS; y^*, EC-12/Japan or Brazil/Argentina real gross national income (GNP), IFS; y, U.S. real gross national income, IFS; E Δp^*, lagged rate of change in EC-12/Japan or Brazil/Argentina consumer price index, IFS; E Δp, lagged rate of change in U.S. consumer price index, IFS; i^*, nominal EC-12/Japan or Brazil/Argentina discount rate, IFS; i, U.S. 6-month T-Bill rate, IFS. IFS, International Monetary Fund, Washington, DC: International Financial Statistics, various issues. Figures in parenthesis are t-statistics.

**, Significance level = 0.01.

*, Significance level = 0.1.

– , Excluded based on multicollinearity considerations.

TABLE 4

Estimated soybean trade equations, 1965–1985

USXP, BAXP and EJMP	Constant	WP	CAP	Other variables					R^2	d.f.	D–W
				LXP	SWP	Real GNP	D72	D73			
1. Soybeans											
a. U.S.	2.657	0.229 **	0.129	0.818 ***				–	0.912	16	2.07
	(2.83)	(2.26)	(0.65)	(13.63)							
b. Brazil and	4.918	0.686 ***	1.130 *	0.237 **			1.963 ***		0.926	15	2.14
Argentina	(2.68)	(2.64)	(1.94)	(2.03)			(6.42)				
c. EC-12 and	20.356	−0.701 ***			0.411 ***	1.697 ***		–	0.978	16	1.42
Japan	(28.06)	(−5.01)			(4.60)	(14.73)					
II. Soymeal											
a. U.S.	13.035	0.172 **	5.745 **	–				−0.167 *	0.816	16	1.48
	(74.52)	(2.31)	(9.85)					(−1.48)			
b. Brazil and	13.573	−0.298	0.389	–			2.893 ***		0.793	16	1.04
Argentina	(3.40)	(−0.37)	(1.10)				(6.62)				
c. EC-12 and	17.256	−0.173 *			−0.108	3.415 ***		−0.177 *	0.958	15	1.12
Japan	(23.04)	(−1.17)			(−0.80)	(19.29)		(−1.72)			

The model is estimated using Seemingly Unrelated Regression Estimation (SURE). The variables are in logarithm forms and are defined as: USXP, quantity of U.S. exports of soybeans or soybean meal to EC-12 and Japan (marketing year), FATUS; BAXP, quantity of Brazil/Argentina exports of soybeans or soybean meal to EC-12 and Japan (marketing year), a proxy data, ATY; EJMP, quantity of EC-12/Japan imports of soybeans or soybean meal from the U.S., Brazil, Argentina (marketing year), FATUS and ATY; WP, real world price of soybeans of Decatur or soybean meal at European ports deflated by consumer price index, this world price is multiplied by the exchange rate to become local currency, ATP; CAP, export capacity in exporting country of soybeans or soybean meal calculated by dividing total domestic supply, including stocks with total domestic use, USDA; LXP, lagged dependent variable; WWP, real price of substitutable product of soybeans or soybean meal, ATY; GNP, real gross national income of EC-12 and Japan, IFS, D82, dummy variable equals 0 prior to 1972 and 1 after 1971 for the Brazil/Argentina equations; D73, dummy variable equals 1 in 1973 and 0 otherwise for U.S. and EC-12/Japan equations. Figures in parentheses are t statistics.

***, Significant level is 0.99. **, Significant level is 0.95. *, Significant level is 0.85. –, Excluded based on multicollinearity consideration.

In EC-12 and Japan, the estimated coefficient on world price in real local currency is negatively related to their imports of soybeans. As the U.S. decreases monetary growth and pushes up the value of the dollar, the real world price faced by EC-12/Japan soybean importers increases. Thus, EC-12/Japan soybean imports decline. Rapeseed is a primary import substitute for soybeans and its price is positively related to soybean imports. As the price of rapeseed increases, EC-12 countries would prefer soybeans as an import substitute. The real income level has a positive sign as expected. The increasing real income in EC-12 and Japan increases the imports of soybeans.

Soymeal export and import equations. In the soymeal market, U.S. soymeal exports respond positively to the world price. Soymeal export capacity is also positively related to exports in the U.S. The estimated magnitude of the capacity coefficient suggests that U.S. soymeal exports are very sensitive to the relative level of total domestic supply to domestic use. If domestic demand for high-protein feed increases at a rate which exceeds the rate of domestic production for crushed soybeans, U.S. soymeal exports will decline to satisfy domestic needs.

In Brazil and Argentina, soymeal export response to the world price in real local currency is statistically insignificant. The policy of encouraging meal exports may explain this lack of response to world price. The export capacity coefficient is positive in sign as expected, however it is not highly statistically significant. The impact of economic growth policies of Brazil and Argentina to enhance their meal exports is captured by the 0/1 dummy variable D72. This coefficient is positive, highly significant, and accounts for most of the explanatory power of the soymeal export equation.

In EC-12 and Japan, the world price in real local currency is negatively related to their imports of soymeal. As the U.S. decreases monetary growth and pushes up the value of the dollar, the real world price faced by EC-12/Japan soymeal importers increases and soymeal imports decline. Cottonseed meal is one alternative substitute for soymeal in EC-12, however, soymeal dominates the EC-12 demand and the price of cottonseed meal is not statistically significant in the EC-12/Japan import equation.

Calculated trade elasticities

The estimated coefficients from the trade model can be used to calculate the elasticities of the world price, U.S. and Brazil/Argentina exports, and EC-12/Japan imports with respect to the U.S. monetary growth rate (see Appendix B). These estimates are obtained by setting those variables in Table 3 and Table 4 with statistically insignificant coefficients to zero,

TABLE 5

Elasticities of exports, imports, and world price with respect to U.S. monetary growth, 1965–1985

Products	World price (WP)	United States (export)	Brazil and Argentina (export)	EC-12 and Japan (import)
I. Soybeans	0.939	0.084 (0.83)	0.995 (0.17)	0.239
II. Soymeal	1.135	0.097 (0.40)	0.000 (0.60)	0.039

Figures in the parenthesis are average export market shares.

which implies that these variables have no long term influence on world soybean trade. Given this, the calculated elasticities are shown in Table 5. Figures in parenthesis are the average market shares of exporting countries.

In the world soybean market, the elasticity of the world price with respect to U.S. monetary growth is positive and close to unity. As the U.S. monetary growth rate increases, the domestic price level increases and the trade value of the dollar relative to other currencies decreases. This rise in the domestic price level decreases U.S. soybean exports in the short run. The value of the dollar remains high relative to the value of Brazil/Argentina currency. Brazil/Argentina soybean exports increase, which implies that Brazil and Argentina maintain their competitiveness over U.S. soybean exports. However, the base level of market share of Brazil/Argentina soybean exports in the EC-12/Japan market is small so that this export competition has little impact on the level of world price. The value of the dollar is lowered in the EC-12/Japan currency market, which increases EC-12/Japan soybean imports. The increased import demand dominates the increased aggregate export supply. As a result, the world soybean price increases in the long run as the U.S. monetary growth rate increases. The estimated elasticity of the world price with respect to U.S. monetary growth can be used to calculate the remaining trade elasticities reported in Table 5.

The elasticity of U.S. soybean exports is positive and very inelastic. Both Brazil/Argentina exports and EC-12/Japan imports of soybeans are increased by an increase in U.S. monetary growth rate. The magnitude of the increased EC-12/Japan imports dominates that of the increased Brazil/Argentina exports. As a result, an increase of U.S. monetary growth will increase U.S. export share in the world soybean market but the magnitude is small.

The elasticity of Brazil/Argentina soybean exports with respect to the U.S. monetary growth rate is positive and close to unity due to its low market share. Decreased U.S. soybean exports due to decreased real price from an expansionary U.S. monetary policy is small in magnitude. Thus, the increased Brazil/Argentina exports satisfy most of the increased demand for soybeans in EC-12 and Japan.

By taking into account the market shares, the actual responses of both Brazil/Argentina and U.S. soybean exports to U.S. monetary growth rate are very inelastic. But, the magnitude of U.S. response is lower than the magnitude of Brazil/Argentina response. Therefore, it can be concluded that a more expansionary U.S. monetary policy does not contribute to an increase in the competitiveness of U.S. soybean exports.

The elasticity of EC-12/Japan soybean imports with respect to the U.S. monetary growth rate is positive but inelastic. This elasticity is simply the weighted average of the two export elasticities. Because the actual response of both U.S. and Brazil/Argentina soybean exports to U.S. monetary growth rate is very inelastic, the import elasticity is also inelastic.

In the soymeal market, the elasticity of the world price with respect to U.S. monetary growth is positive and elastic. As U.S. monetary growth increases, U.S. domestic price level increases. The trade value of the dollar declines relative to EC-12/Japan currency and increases relative to Brazil/Argentina currency. The increased U.S. domestic price level decreases U.S. soymeal exports. The increased Brazil/Argentina exchange rate may increase Brazil/Argentina soymeal exports. However, Brazil/Argentina soymeal exports do not repond to the world price in local currency. An increase in the U.S. monetary growth rate has no impact on Brazil/Argentina soymeal exports.

The decreased EC-12/Japan exchange rate increases EC-12/Japan soymeal imports. The elasticity of U.S. soymeal exports with respect to U.S. monetary growth rate is positive (0.097) and very inelastic. Because of the small U.S. market share of the world market for soymeal exports and a relative small export price elasticity there is relatively little impact on the world soymeal price. Since Brazil/Argentina soymeal exports do not respond to real world price, U.S. soymeal exports must satisfy the increased EC-12/Japan soymeal imports. The low price elasticity of EC-12/Japan soymeal imports (0.039) implies that the import demand response to a price decline is small, thus, U.S. soymeal exports will increase by a small amount.

The elasticity of Brazil/Argentina soymeal exports with respect to U.S. monetary growth rate is zero. This is the result of the lack of response of Brazil/Argentina soymeal exports to the world price in real local currency. In contrast to U.S. soybean exports, it can be concluded that U.S. monetary expansion may contribute to increase the competitiveness of U.S. soymeal exports. These results imply that the net effect of a more expansionary U.S. monetary policy is to increase the competitiveness of U.S. soymeal exports but not soybean exports. This result is due to the fact that the primary effects of U.S. monetary policy are on the world prices.

CONCLUSIONS

This paper investigates the macroeconomic linkage of soybean trade competition between the U.S., Brazil and Argentina in the EC-12 and Japan importing market. Brazil and Argentina attempt to follow a trade policy of devaluing their currency against the currencies of major trading partners in response to changes in their domestic rate of inflation. Effectively implementing this trade policy is confounded by a wide variability in domestic inflation rates and political difficulties that may result from large currency devaluations. Therefore, while a stable real exchange rate is the political goal, this is difficult to accomplish in practice. The importing countries of EC-12 and Japan have restrictive exchange rate policies designed to neutralize the effects of U.S. monetary policy on world trade.

The specification of the trade model provides a reasonable explanation of the structural and policy differentials among the trading countries. In the world soybean market, U.S. and Brazil/Argentina exports respond positively to the world price in real local currency. EC-12/Japan imports respond negatively to the world price in real local currency. U.S. exports are not constrained by export capacity while Brazil/Argentina exports are constrained by their export capacity. This difference is due to the large capacity of U.S. production and the Brazil/Argentina policy of encouraging exports of soybean products rather than raw soybeans. EC-12/Japan imports are mainly driven by the world price in real local currency and domestic real income.

In the world soymeal market, U.S. exports respond to the real world price positively while Brazil/Argentina exports do not respond to price signals. EC-12/Japan imports respond negatively to the world price in real local currency as expected. Both U.S. and Brazil/Argentina exports of soymeal are constrained by their own export capacity. The magnitude of the U.S. export capacity elasticity is significantly larger than the Brazil/Argentina capacity elasticity. This suggests that increasing U.S. export capacity may stimulate U.S. soymeal exports while Brazil and Argentina can marginally increase their meal exports through increased export capacity.

Empirical results presented in this paper further suggest that the soybean export competing country and importing country responses to exchange rates are important. A weak dollar increases imports of soybeans significantly which serves to increase the equilibrium world price and increase both U.S. and Brazil/Argentina exports in the long run. However, the increase in U.S. soybean exports is lower in magnitude than the increase in Brazil/Argentina soybean exports. Total world soybean exports are increased by expansionary U.S. monetary policy. For this reason, the U.S. market share of world soybean trade decreases. Thus, U.S. monetary expansion does not serve to increase the competitiveness of U.S. soybean exports.

A weak dollar also increases imports of soymeal which serves to increase the equilibrium world soymeal price and U.S. soymeal exports in the long run. The lack of Brazil/Argentina response to real world price creates an opportunity for the U.S. to increase soymeal exports as a result of expansionary of U.S. monetary growth. Thus, U.S. monetary expansion serves to increase the competitiveness of U.S. soymeal exports. However, the increase in U.S. market share is likely to be small in magnitude.

The empirical results have the following implication for the competitive position of U.S. soybean exports in world markets. During periods of a strong U.S. dollar, soybean producer groups argue that high U.S. interest rates, as a result a tight U.S. monetary policy, contribute to a decline in the U.S. share of world soybean exports. By implication these same groups argue that lowering interest rates by expansionary monetary policy will lower the value of the U.S. dollar and thereby increase the share of U.S. soybean exports in world trade. The results of this study, which explicitly identifies the linkage between monetary policy, exchange rates and world soybean market shares, suggest that this implication is not correct. U.S. monetary expansion will not lead directly or indirectly to large increases in the market share position for U.S. soybeans and soymeal in world markets.

APPENDIX A

By definition, the elasticity of the exchange rate with respect to U.S. monetary growth rate (M) can be expressed in the form of:

$$\eta_M^e = \frac{\partial e}{\partial M}\frac{M}{e} \tag{A1}$$

where M represents the rate of growth in the U.S. money supply. Replacing M with the discrete form for the change in the supply of money from period $t-1$, to t, the above equation becomes:

$$\eta_M^e = \frac{\partial e}{\partial(\mathrm{MS}_t - \mathrm{MS}_{t-1}/\mathrm{MS}_{t-1})}\frac{(\mathrm{MS}_t - \mathrm{MS}_{t-1})/\mathrm{MS}_{t-1}}{e} \tag{A2}$$

Assuming that the process of U.S. money supply follows a first-order autoregressive model, (Mussa, 1976; Meese and Rogoff, 1983):

$$\mathrm{MS}_t = \delta\ \mathrm{MS}_{t-1} + \mu_t \tag{A3}$$

the relationship between current and lagged level of money supply can be expressed as:

$$d\ \mathrm{MS}_t = \delta\ d\ \mathrm{MS}_{t-1} \tag{A4}$$

Totally differentiation of the denominator of the first term on the RHS of (A2) and using (A3) the relationship between the exchange rate elasticity with respect to M and the exchange rate elasticity with respect to (MS) is:

$$\eta_M = \eta_{\mathrm{MS}} \frac{\mathrm{MS}_{t-1}}{\mathrm{MS}_t} \frac{(\mathrm{MS}_t - \mathrm{MS}_{t-1})}{\left(\mathrm{MS}_{t-1} - \dfrac{1}{\delta}\mathrm{MS}_t\right)} \tag{A5}$$

For the United States money supply an AR(1) regression yields an estimated coefficient of +1.077. Using this estimate and the mean levels of money supply along with equation (A5), the relationship between the elasticity with respect to money supply and that with respect to growth rate can be expressed as:

$$\eta_M^e = \eta_{\mathrm{MS}}^e(-0.4339) \tag{A6}$$

APPENDIX B

The elasticities of the world price and U.S. soybean exports are obtained by replacing the terms on the RHS of equations (15) and (16) with their estimated values as follows. From the elasticity equation (15) the numerator becomes {0.83(0.229)(−0.57) + 0.17(0.686)(−1.182)(−0.434) − (0.701)(2.95)(−0.434) = −0.94601}. The denominator in (15) is [−0.701 − 0.83(0.229) − 0.17(0.686)] = −1.00769. Thus, the elasticity of world soybean price with respect to U.S. monetary growth is equal to 0.939.

The estimated value for the elasticity of $1/\mathrm{CPI}_a$ with respect to U.S. monetary growth rate is −0.57. This figure is obtained from the direct estimation of the following log-linear model $\{1/\mathrm{CPI}_a = -3.18^{**} - 0.57^{**}M,\ R^2 = 0.29\}$. The coefficient of M becomes the elasticity of the reciprocal of U.S. price level with respect to U.S. monetary growth rate.

To calculate the elasticity given as equation (16) and numerator is {−0.701[(2.95)(−0.434) + 0.939] − 0.17(0.686)[(−1.182)(−0.434) + 0.939] = 0.0699}. The denominator in (16) is 0.83. The elasticity of U.S. soybean exports with respect to U.S. monetary growth rate is equal to 0.084. The weight factor (−0.4339) from Appendix A converts the elasticity of the exchange rate with respect to U.S. money supply into that with respect to U.S. monetary growth. The other calculated elasticities can be obtained by using the same technique.

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