THE INFLUENCE OF UNITED STATES MONETARY POLICY ON ARGENTINA AND BRAZIL SOYBEAN SUPPLY RESPONSE

Pei-Chi Peggy Chen, Stanley M. Fletcher and Chung-Liang Huang
University of Maryland and University of Georgia

ABSTRACT

U.S. monetary policy influence on Argentina and Brazil soybean supply response was investigated. An econometric model was constructed. While some economists hypothesized that a tight U.S. monetary policy coupled with the countries debt burden would encourage their soybean production, the results suggested that their domestic policy concerns were more dominant.

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Author(s) Name	Institution
Pei-Chi Peggy Chen	University of Maryland
Stanley M. Fletcher	University of Georgia
Chung-Liang Huang	University of Georgia

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Name, mailing address, and phone number for contact person

Stanley M. Fletcher, Dept. of Agr. Economics, Georgia Station, Experiment, Georgia 30212 404-228-7231

Name and biographical sketch (<50 words) of presenting author

Pei-Chi Peggy Chen is a graduate research assistant in the Department of Agricultural and Resource Economics, University of Maryland. She received her B.S. from National Chung-Shing University, Taiwan, R.O.C. and her M.S. from the Dept. of Agricultural Economics, University of Georgia. Her area of research is agricultural supply and demand analysis and international trade.

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Pei-Chi Peggy Chen, Stanley M. Fletcher
and Chung-Liang Huang

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Authors are former Graduate Research Assistant and Associate Professors, respectively, Department of Agricultural Economics, Georgia Experiment Station, University of Georgia, Experiment, Georgia 30212. The first author is now a Graduate Research Assistant, Department of Agricultural and Resource Economics, University of Maryland.

THE INFLUENCE OF UNITED STATES MONETARY POLICY ON ARGENTINA AND BRAZIL SOYBEAN SUPPLY RESPONSE

During the 1970s, U.S. agriculture benefited from a low rate of real interest and a relatively weak dollar which helped expand export markets. As a result, many farmers bought land and equipment to expand their farming operations with the expectation of continuous growth in agricultural exports. However, there was a drastic change in the U.S. monetary policy in the late 1970s which totally changed farmers' expectation. In October 1979, the U.S. switched to a tight monetary policy in order to bring price inflation under control.

This change in monetary policy drove up the real interest rate and led to an increase in capital inflow as well as an appreciation of the U.S. dollar. The impact of the dollar appreciation decreases foreign demand for U.S. agricultural products. Furthermore, a global recession occurred during the same period and reduced the aggregate demand for U.S. agricultural exports. All of these factors caused the U.S. and world prices, especially soybean prices, to plummet which, in turn, further increased U.S. farmers' financial stress (McCalla).

Since the 1970s, there has been a worldwide debt crisis. This problem has important implications for the uncertainty in the U.S. commodity markets (Dunmore). The special financial problems of the debtor nations have impacted the international trade by changing the structure of world grain market. More specifically, for the importing countries, the demand for imports was reduced due to the unavailability of foreign exchange (dollars). For exporting nations, the supply of exports increased in order to generate needed foreign exchange. This resulted in a glut in the world grain markets and, hence, structural change. Moreover, given the importance of the U.S. dollar in the world financial market, the present U.S. monetary policy also affected these debtor nations in terms of higher interest payments and an increased cost of buying dollars.

Soybean production in the U.S. has increased rapidly since the early 1970s and it ranks second in the value of crops produced. The soybean sector is important to U.S. agricultural trade because this country is the world's largest soybean supplier. However, the U.S. dominance of the world soybean market has eroded in recent years because of the increasing supply of South American soybean production, namely, Argentina and Brazil. These two countries have become the major soybean export competitors of the U.S. The U.S., Argentina and Brazil accounted for approximately 80.3% of the total world soybean production in 1984. It is interesting to note that while the U.S. is trying to reduce its soybean production in response to the declining demand, these competing countries are increasing their production as well as exports in an effort to gain some of the U.S. export markets.

The main purpose of this study is to identify the important and influential factors that cause Argentina and Brazil to expand their soybean production. Among some of the questions to be answered in the study are: Is the U.S. monetary policy a critical factor responsible for encouraging foreign production at the expense of the U.S. production? What are the magnitudes and to what extent do foreign producers respond to U.S. monetary policy? However, due to the page constraint, the economic model is not presented in detail but the reader may obtain it from the authors upon request. The following section provides a brief overview of the model and the statistical results. An analysis of the findings are reported next with conclusions and implications based on the results last.

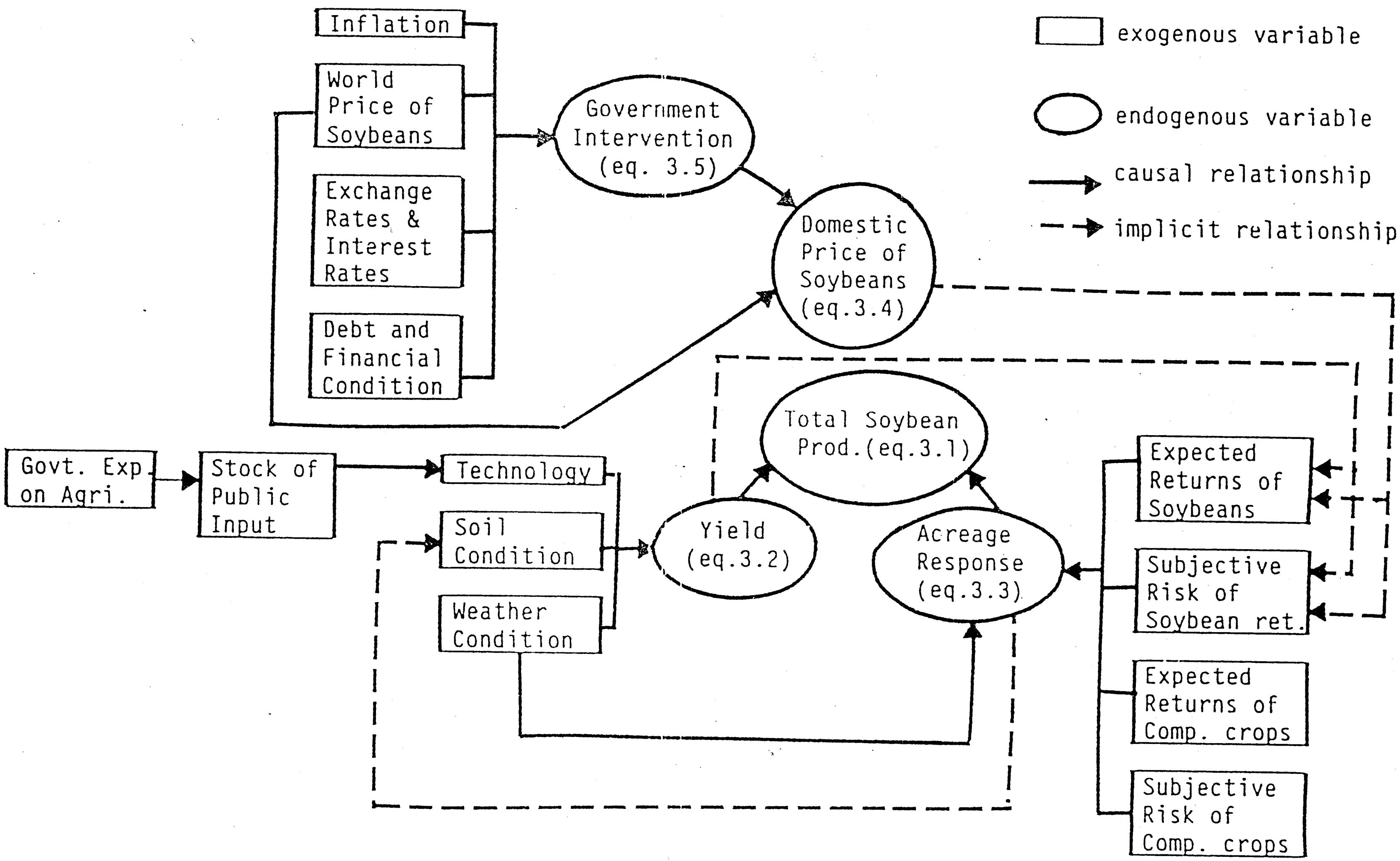
Model

The theoretical framework of the soybean supply response model for Argentina and Brazil consists of three behavioral equations and two identities. The behavioral equations are, respectively, the yield equation, the acreage response equation, and the government intervention equation. The two identities are the aggregate production identity and the price linkage identity. The structural relationships and the basic economic factors of the model are depicted in Figure 1. This framework follows closely the works by Gulliver, Mielke, Thompson, Williams, and Williams and Thompson.

Figure 1 is simplified in the sense that it provides an overall "snap shot" of the basic economic factors and relationships involved in an otherwise quite complicated economic structure. For example, it can be identified from the diagram that soybean yield per acre is hypothesized as a function of weather condition, technology and soil fertility. In addition, Figure 1 also shows that soybean production in a country is a function of yield and acreage response which, in turn, is assumed to be a function of weather condition and a host of other economic variables. Thus, a given change in weather condition is shown to have affected both yield and acreage response.

A system estimation method such as full information maximum likelihood would be appropriate for the estimation of the structural parameters of the soybean supply response model (Judge, et al).

Figure 1. The soybean supply response model for Argentina and Brazil



However, the acreage response equation is a Just-type formulation. Since there is no known method to incorporate the Just-type equation into a system estimation, the structural equations are estimated separately. The government intervention and the yield equations are estimated by the ordinary least squares procedure, while a maximum likelihood estimation procedure as described by Just is employed to estimate the acreage response equation for both countries.

The period for crop years 1966-1983 was used for the analysis. More recent data was not available, and the year 1966 was chosen as a starting point because of data availability. All data utilized are on an annual basis and have been published by U.S. government agencies or world agencies (see reference for list). All monetary values are in real terms using 1980 as the base year.

Results

The statistical results indicated that the model was quite satisfactory in explaining Argentina's and Brazil's soybean supply response. The yield equation explained approximately 80 and 85 percent of the variation for soybean yield per hectare in Argentina and Brazil, respectively, and the Durbin-Watson statistic indicated no autocorrelation problem. The results showed that Argentina farmers have more potential in increasing their soybean yield than Brazilian farmers. A possible explanation for this finding is that new soybean acreage brought into production in Brazil has been from relatively less fertile land, while Argentina farmers have not reached that point. Even though the accumulation of government expenditures on agriculture (stock of public input) was found to be statistically insignificant in the Brazilian yield equation, it does have a significant influence on the yield variation in Argentina. The use of government expenditure on agriculture was a good proxy for technology improvement relative to using a time trend.

The acreage response model explained over 98 percent of the variation in the soybean acreage planted in each country and the Durbin-Watson test statistic indicated no autocorrelation problem. Most of the risk factors in the equations had significant influence on a farmer's decision-making. This finding supports the view that risk should be incorporated into models of supply response and specified separately according to the sources of risk.

The government intervention equation explained 92 and 82 percent of the variation in government intervention of the domestic soybean price by Argentina and Brazil, respectively. The Durbin-Watson test statistic indicated no autocorrelation problem. Although these two countries follow similar policies for their soybean industry, it was interesting they responded differently to the same economic factors. For example, the results indicated a significant positive relationship between the government intervention and Brazil's financial status, while such a relationship was not found for Argentina. A similar scenario was found for the U.S. interest rate in that it had a significant influence on the Argentina government intervention but not on Brazil's intervention. The results further indicated that they respond differently when faced with the pressure of encouraging exports. While both countries encourage exports by means of encouraging production and export of high value products (e.g., soybean meal), Argentina increases the level of government intervention in the soybean market, while Brazil decreases its intervention.

Application of the Model

The major focus is to examine the influence of U.S. monetary policy on Argentina and Brazilian soybean supply. Based on the estimated models, the effects of a change in interest rate and exchange rate on each country's soybean supply can be traced through the structural equations to provide a reduced form impact analysis.

The net impacts of each variable on the soybean supply can be expressed by a multiplier calculated by substituting the equations into the reduced form and deriving the partial derivative of the soybean supply with respect to the variable examined (i.e., exchange rate, and interest rate). The formulas for the computation of exchange rate multiplier and interest rate multiplier in each country are summarized in Table 1.

The derived values of the multipliers for exchange rate and interest rate for the past three years (1980, 1981, 1982) to the soybean supply in 1983 for both countries are calculated and presented in Table 2. However, since the coefficient for interest rate in the Brazilian government intervention equation was not statistically significant, the multiplier for the Brazilian soybean supply with respect to the interest rate was not calculated.

The impact of the exchange rate on soybean supply was found to have different effects on each country's supply. Argentina's exchange rate impact was found to have a positive influence on the soybean

Table 1. Formulas of the multiplier

Argentina:

$$M_{t-k-1,1} = [PW_{t-k-1} - g_1][d_1 \alpha (1-\alpha)^k + 2f_1 \beta (1-\beta)^k \varphi_{t-k-1}][Y_{t-k-1}][Y_t]$$

$$M_{t-k-1,2} = [-g_2][d_1 \alpha (1-\alpha)^k + 2f_1 \beta (1-\beta)^k \varphi_{t-k-1}][Y_{t-k-1}][Y_t]$$

Brazil:

$$M_{t-k-1,1} = [PW_{t-k-1} - g_1][d_1 \alpha (1-\alpha)^k + 2f_1 \beta (1-\beta)^k \varphi_{t-k-1}][Y_{t-k-1}][Y_t + (a_3 + 2a_4) A_t]$$

$$M_{t-k-1,2} = [-g_2][d_1 \alpha (1-\alpha)^k + 2f_1 \beta (1-\beta)^k \varphi_{t-k-1}][Y_{t-k-1}][Y_t + (a_3 + 2a_4) A_t]$$

$M_{t-k-1,j}$, denotes the multiplier of jth factor in $(t-k-1)^{th}$ time period to soybean supply in time t.

g_j = estimated coefficient for jth factor in government intervention equation,

j=1 exchange rate, j=2 interest rate.

Y_{ti}, Y_{t-k-1} = soybean yield per hectare in the t^{th} and $(t-k-1)^{th}$ period of time, respectively.

$\varphi_{t-k-1,i}$ = a mathematic composition, (authors can supply the formulations upon request).

A_t = Soybean acreage planted in time t.

PW_{t-k-1} = world soybean price in $(t-k-1)^{th}$ period of time.

a_3 = coefficient of soybean acreage planted in yield eqution.

a_4 = coefficient of squared term of soybean acreage planted in yield equation.

d_1 = coefficient for expected returns for soybeans in acreage response equation.

f_1 = coefficient of subjective risk of soybean returns in acreage response equation.

α, β = scalar geometric parameters in the positive unit interval from the acreage response equation.

Table 2. The multiplier and elasticity of exchange rate and interest rate for the years 1980, 1981 and 1982 to soybean production in 1983, Argentina and Brazil

Factor change in year	Exchange rate		Interest rate	
	Multiplier[a]	Elasticity[b]	Multiplier[c]	Elasticity
			Argentina	
1980 (k=2)	0.34	0.47	-21.52	-0.062
1981 (k=1)	0.29	0.14	-23.35	-0.06
1982 (k=0)	0.11	0.15	-18.55	-0.05
	Brazil			
1980 (k=2)	-63.68	-0.31		
1981 (k=1)	-86.306	-0.43		
1982 (k=0)	-112.394	-0.61		

[a]The multiplier is based on a 1000 metric ton change in soybean production due to a peso increase in the real exchange rate.

[b]The elasticity is the product of the multiplier and the ratio of the means of real exchange rate and production. The means are based on the years 1975-83.

[c]The multiplier is based on a 1000 metric ton change in soybean production due to a percentage point increase in the real interest rate.

production, while for Brazil, the impact was found to be negative. An interpretation of this finding is the Argentina government reaction to a change in the exchange rate is not responsive enough to offset the price expanding effect due to the increase in exchange rate. However, in the case of Brazil, the price expanding effect is offset by the government's response to the change in the exchange rate. Furthermore, in order to remove any unit effects, the impacts were converted to elasticities for comparison purposes (Table 2). The elasticities calculated for both countries showed Brazil to be relatively more responsive in soybean supply from an exchange rate change than Argentina.

The impact of a change in the U.S. interest rate on Argentina's soybean production was investigated. While the interest rate multiplier for Argentina was large in terms of magnitude, the interest rate elasticity was relatively inelastic especially when compared to the exchange rate elasticity. For example, a one percent increase in the interest rate would cause an approximately 0.06 percent decline in soybean Argentina's production.

Conclusion

The major focus of this study was to investigate the influence of U.S. monetary policy on Argentina and Brazil soybean supply response. In particular, the null hypothesis that the U.S. monetary policy does encourage our foreign competitors' production was tested. The U.S. interest rate and the exchange rate between the U.S. and the studied country were the variables used to represent the U.S. monetary policy. An econometric model for these two country's soybean production was constructed.

The results from this study provided some interesting findings. While some economists hypothesized that the tight U.S. monetary policy coupled with the two studied countries' debt burden would encourage these competitors' soybean production, the results suggested that each country's domestic policy concerns were more dominant. That is, the pressure from a strong U.S. dollar and high interest rates (representing U.S. monetary policy) did not really encourage foreign soybean production. Only the exchange rate was found to have a positive influence on soybean production but this was just for Argentina. However, this influence was due to the domestic price expanding effect from an increase in the exchange rate (i.e., price farmer received = world price times exchange rate) and not from government encouragement.

To more fully understand this finding, alternative factors must be considered. One can obviously note that the government policy still has a positive impact on the soybean price intervention in both countries which is a negative impact on their domestic soybean price. Intuitively, a negative influence on the soybean price should result in a negative influence on soybean production. However, due to the expanding effect on domestic price through the exchange rate, the net effect of an increasing exchange rate (i.e., strong dollar) has a positive impact on Argentina's soybean production. In contrast, the magnitude of the Brazilian government's response to the exchange rate is large enough to offset the expanding effect of the domestic price. Consequently, the strong dollar did not have a positive influence on the Brazilian soybean production, <u>ceteris</u> <u>paribus</u>.

These results provide additional support to earlier findings of Williams and Thompson. They found that the Brazilian government intervention during the seventies restricted the growth of their soybean production. This restriction offset the stimulative effects of their intervention in the soybean meal and oil markets. This prevented the attainment of the very objective for which the intervention was undertaken (i.e., to encourage exports).

The implication of the results from this study are that the strong dollar and tight money supply the U.S. government has been pursuing since the late 1970s plus the global financial crisis (debt problem) have not had a positive influence on Argentina's and Brazil's soybean production. While the response directions did not follow the intuitive expectation as argued by most economists, these macroeconomic factors were found to be important variables.

The common viewpoint is that much of what affects agriculture in today's world is a result of forces external to the farm sector. How these U.S. macroeconomic factors affect an individual country's government intention is extremely important when dealing with questions of international trade. Thus, except for Argentina's response to a change in the exchange rate, the results do not indicate that the devaluation of the U.S. dollar or the decrease in the interest rate would cause a decrease in Argentina's and Brazil's soybean production. In other words, changing U.S. monetary policy in order to regain the U.S. competitiveness in the world soybean export market does not seem feasible over the time period studied.

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