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In this paper an effective U.S. agricultural exchange rate was constructed and its determinants were contrasted with those of the Federal Reserve effective rate. The obtained results indicate that financial market variables determine both exchange rates.

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Since the breakdown of Bretton Woods in March, 1973, exchange rates among principal currencies have been allowed to vary in response to market forces. Despite occasional interventions by national monetary authorities, short-run exchange rate movements have been far greater than the corresponding movements in the underlying economic variables--such as money stocks, interest rates, prices, and trade balances--which traditionally have been suggested as explanations of exchange rates. Since floating exchange rates depend on domestic and international economic conditions, it is important to understand the sources of this exchange rate volatility.

This increased exchange rate volatility under the regime of floating rates is of particular importance to American agriculture. A number of authors (Schuh (1976, 1981), Chambers and Just, McCalla, Pagoulatos and Canler) have pointed out that unstable monetary policy affects the agricultural sector via its effect on exchange rates and agricultural trade. As a first step in understanding the role of monetary instability in influencing the prosperity of the agricultural sector, one needs to investigate the forces that determine the dollar exchange rate in the short run.

In this paper an agricultural trade-weighted dollar exchange rate is computed and its economic determinants examined through multiple regression analysis. The results for the effective agricultural exchange rate are then compared to those obtained for the effective dollar exchange rate computed by the Federal Reserve.

Exchange Rate Determination

The contemporary theories on the determination of the flexible exchange rate are generally limited to the short run, largely because in the long-run the exchange rate and many of its determinants begin to affect each other;

modeling becomes very complex. One group of models, representing the "portfolio-balance or asset approach," assume that foreign and domestic bonds are imperfect substitutes and stress portfolio considerations in financial markets (Branson, Isard). Specifically, portfolio holders seek the optimal balance of domestic and foreign assets in light of their returns and risk differentials. The other group of models, the "monetary approach," assume foreign and domestic assets to be perfect substitutes, so that portfolio holders are indifferent between the two (Dornbusch, Frenkel). Additionally, the monetary models assume wealth effects to have no role in determining the exchange rate, so it is possible to focus only on money market equilibrium for exchange rate determination. Thus, the "monetary approach" to the exchange rate is a special case of the "asset approach."

Although the literature on exchange rate determination has concentrated on bilateral rates, there have also been contributions on multilateral or effective rates. These rates usually are composites constructed by taking a weighted average of different exchange rates. The weights reflect the importance of different countries to a nation's trade. The model presented here is based on the work by Larson and Porter.

Following their arguments, movements in the exchange rate can be explained by four determinants: a) the supply of money M, b) the general price level P, c) aggregate real income Y, and d) the cumulative current account deficit. The reasoning for this conclusion follows "monetary" lines.

All currencies in circulation are held in the wealth portfolios of individuals. The proportions in which people hold the currencies of different countries in their portfolios depend on their needs and desires based on present and future economic conditions. The exchange rate is an important factor behind the mix of currencies they will want to hold in their portfolios: they will want to hold currencies they expect not to depreciate so that they will not suffer a loss in wealth. As the exchange rate changes, people's expectations about which currencies will appreciate or deprecite may change. Therefore, people may want to readjust the currency mix in their portfolios. An equilibrium exchange rate is achieved when people are just willing to hold the existing stock of each money, i.e. no one wants to adjust his currency mix further.

With this portfolio approach the determination of the exchange rate can be explained fairly simply. Consider the demand and supply of cash balances. The demand is partly determined by people's income and the general price level. The higher incomes and prices are, the higher is the demand for money. More cash is needed to meet transaction needs at higher incomes and prices. This need can be met by obtaining dollar cash balances through the sale of foreign currencies. The movement out of foreign currencies drive down their value relative to the dollar. The relative value of the dollar rises until people become unwilling to sell off more foreign currencies. Following this reasoning, aggregate income Y and the general price level P are positively related to the exchange rate.

Conversely, the supply of money M is negatively related to the exchange rate. An increase in the money supply finds people holding more dollars than they desire. They attempt to sell dollars for other currencies, precipitating a fall in dollar prices. The fall will continue until people are satistified with the value of the stocks of dollars and foreign currencies they hold. A long-run model would need to consider the feedback effects of changes in the money stock on prices and income, but are assumed unimportant within the one quarter-framework of the present model.

If the United States begins to run a current account deficit, financial wealth is transfered to foreigners who have less need than Americans to hold dollar cash balances (relative to total financial wealth). Since the people receiving dollars are less willing to hold them, they attempt to sell. The price of the dollar is driven down until everyone is again satisfied with the dollar content of his portfolio. Thus the current account balance CCA is positively related to the value of the dollar. However, a lagged effect can be expected, since an outflow of dollars must first occur before foreigners begin to feel they are holding too many dollars.

It can also be hypothesized that the interest rate paid on dollar accounts affects the willingness to hold dollars. As the dollar interest rate rises, people in search of higher returns will try to buy dollars, driving up its price. At the same time, however, higher interest rates induce people to economize on cash balances. This reluctance to hold dollars adversely affects the exchange rate. It can also be argued that the interest rate is a variable that represents the demand and supply conditions in the money market, conditions which are already explicitly treated in the model. The effect of international interest differentials, namely, the international transfer of capital is also captured by the current account balance. Thus the interest rate may be considered a superfluous variable which can be safely excluded.

Larson's model basically follows a monetary approach, since it does not include foreign or domestic interest-bearing assets. The implicit assumption is that these assets are perfectly substitutable by foreign and domestic money. The model can be further generalized by assume imperfect substitutability and including the net outflow of capital B as an explanatory variable. An increased net outflow can be expected to lower the dollar exchange rate.

The level of the exchange rate in the previous period is also included. It is assumed that the financial market conditions which make an exchange rate "high" or "low" are not quickly reversed. Therefore, a high exchange rate in the previous quarter is associated with a high rate in the current quarter and vice versa. The coefficient should have a positive sign.

The resulting equation for the determination of the exchange rate ER in the current time period t is:

$$ER_t = f(\overset{-}{M_t}, \overset{+}{P_t}, \overset{+}{Y_t}, \overset{+}{CCA_{t-1}}, \overset{-}{B_t}, \overset{+}{ER_{t-1}})$$

where the sign over each explanatory variable indicates a negative or positive partial derivative.

The U.S. Agricultural Exchange Rate

An effective exchange rate for U.S. agricultural exports AGER has been constructed for the purpose of the present study. This exchange rate is a weighted average of the nine largest importers of U.S. agricultural products which have had floating currencies in relation to the U.S. dollar since the inception of the float. The countries included are Japan, Netherlands, United Kingdom, France, West Germany, Italy, Canada, Spain and Belguim. The weights are calculated by the value of exports to each country as a proportion to the total for the nine countries. These weights change yearly to reflect changes in the export pattern. The results obtained for AGER have been compared to those obtained for an effective dollar exchange rate FEDER based on general U.S. trade weights and published by the Federal Reserve.

The reason for constructing this effective exchange rate for agricultural exports is that agricultural trade flows are often very different from the flows of trade in nonagricultural products. For example, in 1973-81 Japan represented 15.3 percent of the total U.S. agricultural export market but only 8.0 percent of the nonagricultural export market. With differences in the relevant weights, an effective exchange rate for agricultural exports may differ markedly from the published general trade effective rates and thus yield different results in agricultural trade models.

The method used to compute the effective exchange for agricultural exports along with the other variable definitions and data sources are presented in Appendix A at the end of the paper. To facilitate a comparison between the two exchange rates, the agricultural rate (AGER) was indexed with the same base month (March 1973) as the Federal Reserve Board's effective rate (FEDER). It is evident from the inspection of the two indices that both AGER and FEDER have followed similar paths since the inception of the float. An exception appears to be the inflationary period during the late 1970's. The agricultural rate began a recovery while the Federal Reserve rate continued to depreciate. Both experienced a sharp appreciation in the beginning of 1980. It is interesting to note that the general rate FEDER experienced a much sharper depreciation than AGER when the currencies of the industrial economies began to float (Figure at the end of the paper).

The Empirical Results

The exchange rate determination equations for both AGER and FEDER were estimated in double-log form with OLS procedures. However, Durbin's "h test" indicated the presence of first degree autocorrelation. A Cochrane-Orcutt procedure was then used, and the results are presented in Table 1. The quarterly data used in the estimated covered the period from 1973 II to 1981 IV. This period reflects the era of exchange rate flexibility and the availability of data up to the time of estimation.

The general conclusion from the estimated equations is that the coefficient estimates are quite similar in both equations. This result might be expected from the close association over the sample period of the two exchange rates as suggested earlier. After all, Europe and Japan are the major buyers of both U.S. agricultural and nonagricultural exports.

All coefficients in both equations have the expected signs. The coefficient for the net change in U.S. assets abroad (B) was not significant at standard levels in both equations. This result coupled with the statistical significance of the remaining explanatory variables indicates that the "monetary" rather than the "asset" approach provides a better explanation of U.S. effective exchange rates during the period of the float.

The results presented in Table 1 also indicate that, although important, the role of the money supply (M) in the determination of the agricultural exchange rate can be exaggerated. During the period studied in this paper, the average quarterly change in M was 1.53 percent whereas the average change in AGER was 3.1 percent. Using the estimate of the elasticity of AGER with respect to M(.36), it can be shown that changes in the money supply accounted for about 18 percent of the average change registered in AGER. Thus, the other variables- the inflation rate, the real GNP, and the cumulative current

Table 1. Estimation Results for the Agricultural and Federal Reserve Exchange Rate Equations.

Dependent Variable	Explanatory Variables								R_2
	Constant	$\ln M_t$	$\ln P_t$	$\ln Y_t$	$\ln CCA_{t-1}$	$\ln B_t$	$\ln AGER_{t-1}$	$\ln FEDER_{t-1}$	
lnAGER	1.35 (1.34)[a]	-.362 (2.13)[b]	.206 (2.28)[b]	.324 (2.07)[b]	.037 (3.83)[c]	-.035 (1.08)	.418 (3.43)[c]		.828
lnFEDER	1.15 (1.07)	.409 (2.19)[b]	.129 (1.48)[a]	.352 (1.92)[b]	.032 (3.27)[c]	-.003 (.120)		.507 (4.25)[c]	.845

All equations estimated by OLS using quarterly data for 1973 II to 1981 IV. T values are in parentheses.

[a]Significant at the 10 percent level.

[b]Significant at the 5 percent level.

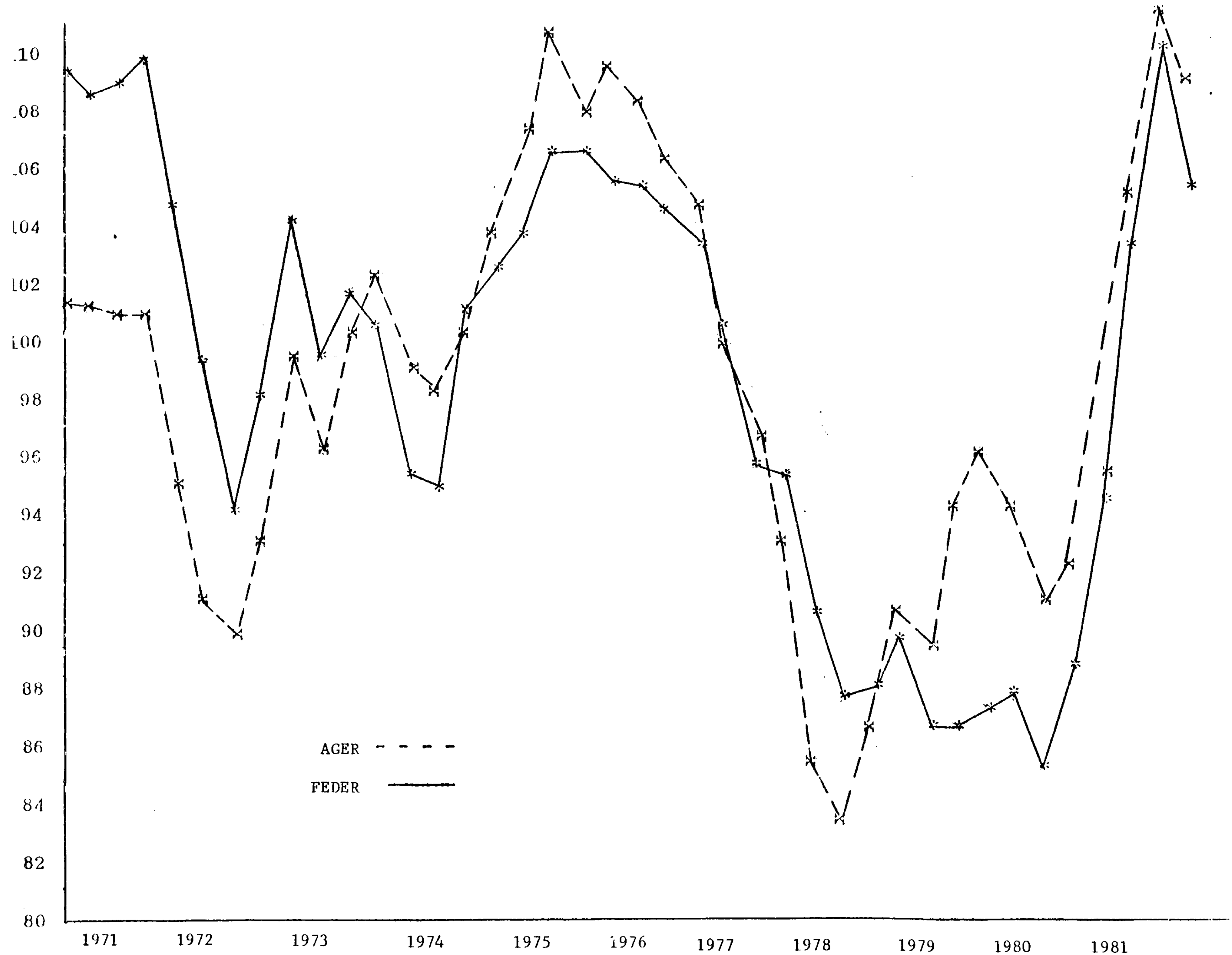
[c]Significant at the 1 percent level.

account balance - also played a role in the determination of the effective agricultural exchange rate. It is these monetary and real factors that ultimately affect the U.S. agricultural sector through their impact on AGER and agricultural exports.

Conclusions

In a world of flexible exchange rates monetary instability is transmitted through the exchange rate to agricultural trade and ultimately to the domestic agricultural sector. It is therefore important to understand the sources of exchange rate volatility.

In this paper an effective U.S. agricultural exchange rate was constructed and its determinants were contrasted with those of the Federal Reserve effective rate. The obtained results indicate that financial market variables determine both exchange rates. Further work needs to be done in order to assess the role of the determinants of these exchange rates in affecting American agriculture.



.10
.08
.06
104
102
100
98
96
94
92
90
88
86
84
82
80
AGER
FEDER
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

APPENDIX A

VARIABLE DEFINITIONS AND DATA SOURCES

AGER

The effective exchange rate for agricultural exports calculated by taking a weighted average of the U.S. dollar exchange rates of Canada, Japan, Italy, France, West Germany, Belguim, Netherlands, Spain and the United Kingdon. The yearly weights were calculated as the proportion of each country's imports of U.S. agricultural products with respect to total imports for the group. These countries were the largest importers with floating currencies. Sources: International Financial Statistics; U.S. Foreign Agricultural Trade.

FEDER

The effective dollar exchange rate is based on general U.S. trade weights. For details on the computation of the exchange rate, see Federal Reserve Bulletin (1978):700.

M

M1 definition of money supply (billion dollars). Monthly figures were averaged for each quarter. Source: Federal Reserve Bulletin.

P

Producer price index for all commodities (1967=100). Source: Survey of Current Business.

Y Gross national product in constant 1972 dollars. Source: Survey of Current Business.

CCA

Cumulative balance on the current account since 1971 I (million dollars). A constant of 30000 was added to all observations to allow estimation in log form. Source: Survey of Current Business.

B

Net outflow of captial measured by the net change in U.S. assets abroad minus the net change in foreign assets held in the United States. A constant of 30000 was added to all observations to allow estimation in log form. Source: Survey of Current Business.

References

Branson, William H. "Exchange Rates in the Short Run: Some Further Results." Europ. Econ. Rev. 12(1979):394-402.

Chambers, Robert G. and Richard E. Just. "An Investigation of the Effect of Monetary Factors on Agriculture." J. Monet. Econ. 9(1982):235-247.

Dornbusch, Rudiger. "Expectations and Exchange Rate Dynamics." J. Pol. Econ. 84(1976):1161-1176.

Frenkel, Jacob A. "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials." Amer. Econ. Rev. 69(1979):610-622.

Isard, Peter. The Process of Exchange Rate Determination: A Survey of Popular Views and Recent Models. Princeton Studies in International Economics 42, 1978.

Larson, Dale W. "The Macroeconomics of U.S. International Competitiveness." Paper submitted to the Economic Trade Policy Analysis Subcommittee of the Trade Policy Staff Committee, Department of the Treasury, 1980.

McCalla, Alex F. "Impact of Macroeconomic Policies upon Agricultural Trade and International Agricultural Development." Paper presented at AAEA meetings in Logan, Utah, 1982.

Pagoulatos, Emilio and Edward Canler. "Macroeconomic Linkages and U.S. Agriculture in a World of Flexible Exchange Rates: A Conceptual Framework." Paper presented at SAEA meeting in Atlanta, Georgia, 1983.

Porter, Michael G. "Exchange Rates, Current Accounts and Economic Activity - A Survey of Some Theoretical and Empirical Issues." Federal Reserve Board, Division of International Finance, June 1979.

Schuh, G. Edward. "The New Macroeconomics of Agriculture." Amer. J. Agr. Econ. 58(1976):802-811.

Schuh. G. Edward. "Floating Exchange Rates, International Interdependence, and Agricultural Policy." Rural Change: The Challenge of Agricultural Economists, eds. G. JOhnson and A. Maunder, NY: Gower Press, 1981.