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Macroeconomic Policy Impacts on United States Agriculture: A Simulation Analysis

Tom Barclay and Luther Tweeten

Department of Agricultural Economics, Oklahoma State University, Stillwater, OK 74078 (U.S.A.)

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Abstract

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United States monetary and fiscal policies influence the domestic agricultural economy directly and, through international linkages, indirectly. This study estimates the magnitude and statistical influence of coefficients relating U.S. macroeconomic policy to the U.S. agricultural economy through domestic and foreign markets. Specific objectives are to specify and estimate a general equilibrium quarterly econometric model of the U.S. macroeconomy and simulate the impact of federal deficit spending on real interest rates, real exchange rates, and net exports of agricultural products. Three hypotheses were tested. The first hypothesis that an increase in federal deficit spending increases the real interest rate could not be rejected; a $100 billion reduction in the U.S. deficit was estimated to reduce real interest rates by two percentage points or more. The second hypothesis that an increase in real interest rate increases the real value of the U.S. dollar in foreign exchange markets had strong support and could not be rejected. A third hypothesis that a rise in the real value of the dollar reduces net exports of U.S. farm products also could not be rejected. Results indicate that the U.S. agriculture would benefit from the lower exchange value associated with an 'optimal' macroeconomic policy. That policy initially made the overall U.S. economy perform less satisfactorily but that performance improves over time.

billion (US) = 10^9.

0169-5150/88/$03.50

Introduction

The conventional economic thought pertaining to net agricultural (or non-agricultural) exports and their relationship to macroeconomic policy changes usually begins with the federal deficit and money supply (see Bradley et al., 1986, for example). When the federal government runs a significant full-employment budget deficit, credit markets must serve sizable private and public borrowing. Increased demand in these markets in the face of a restrictive monetary policy pushes real interest rates higher than they would have been without public borrowing. As foreign investors move capital to the country with higher returns, the demand in currency exchange markets for the particular country's currency increases. Assuming steady money supply growth, the increase in demand for the domestic currency results in a higher real exchange rate. Theoretically, the real exchange rate will increase until real rates of return on investment are equalized. Higher exchange rates reduce agricultural exports, other things equal.

The purpose of this paper is to test hypotheses embodied in the conventional economic thought. The study estimates the magnitude and statistical significance of coefficients relating U.S. fiscal policy to U.S. agriculture through domestic and foreign market linkages. This study quantifies the impact of key macroeconomic variables influencing net exports of agricultural products such as real rates of interest and real exchange rates in a dynamic general equilibrium framework.

The specific objectives of this work are to:

— specify and estimate a general equilibrium econometric model relating U.S. macroeconomic policies to U.S. net farm exports;
— judge the significance of key variables which are used to construct a model of the 'conventional economic thought' concerning net exports;
— simulate the impact of federal deficit spending on the real interest rate, real exchange rate, and net exports of agricultural products.

Hypotheses to be tested are, other things equal:

— an increase in federal deficit increases the real interest rate;
— an increase in the real interest rate increases the real value of the U.S. dollar in foreign exchange markets;
— a rise in the real value of the dollar reduces net exports of U.S. farm products.

Many authors have addressed the question of linkages between agriculture and the economy as a whole. Numerous works were reviewed but only a few dealt with the linkages in a dynamic macroeconomic setting. Included in this latter category are Shei and Thompson (1979), Soe (1980), Penson (1981), and Hughes and Penson (1985). Shei and Thompson integrate theory from the structuralist and monetarist schools of thought into a relatively simple and

manageable economic model. The theoretical foundation herein begins with their synthesis but includes extensive changes in specification and data.

1. Macroeconomic model

To test the hypotheses, a macroeconometric model containing principal linkages between agriculture and the rest of the economy was formulated and estimated. The real and monetary sectors are founded in the structuralist and monetarist schools, respectively.

1.1. Real sector

The theoretical model recognizes that there are structural rigidities in the economy and that prices do not adjust at the same speed in all sectors. A long-held assumption by structuralists is the final neutrality of money, which states that monetary changes eventually raise or lower all prices proportionally. Recent causality tests (Barnett et al., 1981a, b) have provided evidence that monetary changes are not solely passive. A change in the money supply is assumed to impact sectors of the economy differently depending on the competitive structure of the industries.

Also the existence of implicit contracts of varying duration influence price adjustments (Bordo, 1980). Bordo's regressions showed significant influences in adjustment speed between sectors. Considering the adjustment differences, Bordo (p. 1089) stated, "The conditions required for final neutrality to hold, at least in the short run, are very stringent indeed."

Output of the real sector is divided into agricultural and nonagricultural products. Agriculture is viewed in the structuralist conception as a perfectly competitive sector which produces homogeneous goods whose prices are flexible. Nonagriculture is viewed as being oligopolistic, producing heterogeneous goods under increasing returns to scale. Financial barriers impede entry of new firms. Prices in the nonagricultural sector are set on the basis of a profit margin over variable costs of production. Nominal nonagricultural prices, being cost-determined, tend to be inflexible downward.

Both sectors of the economy have prices and quantities that are simultaneously determined. Total national income is the sum of the prices times output in the two sectors. Each sector must satisfy the market clearing condition that production plus imports must equal domestic absorption plus exports. A large-country assumption is maintained for the two export sectors: U.S. market shares are sufficiently large so that its actions have a perceptible impact on world prices. Homogeneity of export goods is assumed between the U.S. and the rest of the world. The law of one price is assumed to hold, such that domestic prices equal world prices adjusted for the rate of exchange.

Following Alexander's (1952) absorption approach to the balance of pay-

ments, the dependent variable in each demand equation is the real domestic absorption of the given sector's output. Absorption is defined as the sum of domestic consumption, investment, and government purchases. Real aggregate national expenditure is substituted for real per capita income in each equation. The rest of the explanatory variables follow conventional microeconomic theory with own price and the price of substitutes as variables.

In the absorption approach, the national budget constraint requires that the difference between domestic expenditure and national income be exactly equal to the value of imports minus exports in the long run. New money enters the system through aggregate expenditures. Domestic credit creation directly increases expenditures in the model. The coefficient of aggregate expenditure in the domestic disappearance equations are interpreted as the marginal propensity to absorb a given sector's output out of an increase in the supply of money. Differences in this marginal propensity across sectors help explain why monetary shocks have different impacts on the respective sector.

The supply equations in this model are consistent with the structuralist specification outlined previously. Agriculture is viewed as the flexible price sector. Therefore in the supply equation quantity is a function of market prices. In contrast, nonagriculture is specified as the fixed price sector. Price changes are based on the 'cost-plus' concept and are regulated by the quantity supplied to the market. Because prices in this sector are affected by labor costs and productivity, a labor market is specified to interact with the supply of nonagricultural goods. When the rate of unemployment or productivity is high, nonagricultural prices tend to stabilize. Therefore, the supply of goods in this sector is simultaneously determined with the labor market adjusted for productivity.

Foreign trade in both sectors is specified as a net flow of products. The agricultural sector is specified as a net export sector while nonagriculture is a net import sector. It is assumed that internationally traded goods are homogeneous and perfectly substitutable for foreign goods of the particular sector. The trade equations confronted by the U.S. in each sector are specified as a function of the respective U.S. export-import price, the exchange rate (G-10), foreign income (or domestic income in the net import equation), and other foreign supply or demand shifters. Balance of trade is defined as the total value of exports minus imports.

1.2. Monetary sector

The absorption approach, as advanced by Alexander, assumes that real aggregate expenditures in the economy are not necessarily equal to real national income in the short run. The difference between the two is equal to the difference between the actual stock of money in the economy and the long run desired stock that people wish to hold. That is, if the current stock of money exceeds demand, desired real aggregate expenditures will exceed real national

income as individuals reduce their stock of money by making purchases. When the opposite situation occurs people reduce purchases and increase savings as they attempt to rebuild their real balances (Mundell, 1968). In this approach full equilibrium is not attained; only some fraction of the difference between actual and desired real balances is eliminated in any one period.

Desires by economic agents to hold real balances are not limited to the domestic economy. Foreigners also have some level of real balances in U.S. dollars that they wish to hold. The monetary sector model explains hoarding and dishoarding of real balances in U.S. dollars through currency exchange markets, the flow of capital between the U.S. and the rest of the world, and real rates of return.

The key to the desires of economic agents to hold real balances in U.S. dollars is the real rate of return on those dollars. When the real rate of return on dollars increases to levels above those offered by other countries, capital will flow to the U.S. economy. As individuals shift from other currencies to dollars in foreign exchange markets, the demand for U.S. dollars increases. This increase in the demand for dollars in the face of a limited supply forces the real exchange rate higher. The actual increase is influenced by the rate of increase in money supply by the Federal Reserve Bank.

It is important to note that an increase in the official balance of payments, whether from net capital inflows or an excess of export revenue over import expenditure, expands the monetary base and in turn the money supply. The monetary authority can offset the increase by autonomously altering the domestic component of the money supply. This process, known as sterilization, can represent an important link between economic forces that dictate capital valuation and governmental policy actions.

Real rates of return in the model are represented by the real rate of interest on short-term loans. The real interest rate is specified as the prime rate minus inflation which is represented by the change in the implicit price deflator of gross national product. Factors assumed to influence the real interest rate are the real exchange rate, net capital outflows, gross private domestic investment, the supply of high power money (M1-B), and the federal deficit. The federal deficit is of special interest here because of its hypothetical impact on the real interest rate.

Real exchange rates are represented by the U.S. rate of exchange relative to the G-10 countries and adjusted for inflation on a trade weighted basis. Factors which are assumed to determine the real exchange rate are the real interest rate, balance of payments, the differential between foreign and domestic interest rates, and the changes in domestic interest rates. Other factors which theoretically should have impacts showed little significance in the equation.

The final equation specified in the monetary sector explains net capital outflow. The dependent variable in this equation is assumed to be influenced by real rates of return which determined the direction of the flow. Real exchange

and interest rates are assumed to be the primary factor which influence the flow of capital. Other factors such as the difference between foreign and domestic interest rates are also included.

In short, the monetary sector of the econometric model of necessity must abstract from some workings of the complex monetary system. But it captures the essence of economic actors' desires to hold real balances.

2. Econometric model

Parameters of the simultaneous equation model were estimated by two-stage least squares using quarterly data from the beginning of 1970 to the end of 1984 (Table 1). The choice of periods was dictated by availability of data but is of sufficient duration to exhibit considerable macroeconomic variability useful in estimation of parameters. A system method such as three-stage least squares was deemed less desirable because it transmits specification error throughout the system. Structural estimates are reported with t-values in parentheses and short-run elasticities in brackets. In preliminary experimentation, some variables were deleted from certain equations because of wrong signs and/or insignificant parameter estimates.

In the first two equations in Table 1, explanatory variables account for 99% of the variation in domestic absorption of all nonagricultural products (DDNA) and for 82% of the variation in domestic absorption of agricultural products (DDA). As expected, nonagricultural product disappearance is more sensitive than is agricultural product disappearance to aggregate expenditures and also to prices PNAD and PAD. All coefficients of these variables are highly significant and have correct signs. According to the coefficients of AED, from a $1 increase in aggregate expenditures (AED) arising from an increase in money supply or other source, agriculture would absorb 2¢, nonagriculture 60¢, and inflation and other factors would absorb the remainder. The producer price index PAD (sometimes called the wholesale price index) is a measure of prices received by farmers so the negative sign on its coefficient is expected in a demand equation.

According to the export-import equations in Table 1, net agricultural exports DXDA are significantly influenced by the real exchange rate ERA. Each 1% increase in ERA reduces net agricultural exports 1.5% in the short run and 2.5% in the long run. These results are consistent with those of Chambers and Just (1981, p. 44). The insignificant coefficient for ERA in the DDNA equation could occur because real exchange rates negatively influence exports as much as they positively influence imports, hence net imports DDNA are not influenced significantly.

As expected, higher farm product prices reduce stocks DSKA (stock demand equations) and expand production DSA. High real interest rates would be expected to reduce stocks but the coefficient of ERA was highly dependent on government inventory decisions.

TABLE 1

STRUCTURAL EQUATIONS OF THE REAL SECTOR

Disappearance equations

DDNA = 125038.60 − 189880.00 PNAD + 0.60 AED + 726.29 POP + 0.02 DDNAL
(6.58) (26.02) (12.26) (5.26) (0.45)
[−1.12] [0.86]
$R^2 = 0.99$ $F = 1903.30$

DDA = 4852.35 − 800.89 PAD + 0.02 AED + 0.25 DDAL
(4.84) (−2.21) (5.18) (1.84)
[−0.10] [0.47]
$R^2 = 0.82$ $F = 65.77$

Export-Import equations

DXDA = 960.35 − 1204.69 PAD − 2258.97 ERA + 0.0031 YF + 0.40 DXDAL
(0.44) (−2.94) (−3.11) (2.28) (3.01)
[1.18] [1.48] [2.61]
$R^2 = 0.79$ $F = 65.77$

DIDNA = 5806.57 − 14429.40 PNAD + 1009.31 ERA + 0.04 YD + 0.32 DIDNAL
(0.88) (−3.12) (0.43) (3.16) (2.23)
[−1.31] [0.06] [0.87]
$R^2 = 0.64$ $F = 18.47$

Stock equation

DSKA = 51090.61 − 16142.70 PAD + 0.04 DSKAL
(9.35) (−9.11) (0.35)
[−0.76]
$R^2 = 0.88$ $F = 18.47$

Production equations

DSA = 47266.02 PAD − 4085.31 PPF PCPNA = 0.03 PCW + 58.22 PCPIDNA
(14.03) (−5.90) (3.18) (3.67)
[0.71]
$F = 2031.58$ $F = 12.13$

Philips curve equation

PCW = 1.71 − 0.05 U + 91.79 PCHPMS
(1.09) (−0.19) (4.71)
$R^2 = 0.34$ $F = 11.13$

Aggregate expenditures equation

AED = −13097.90 + 1.005 YD − 147.51 RPR − 420.19 U + 0.05 AEDL
(−4.60) (15.61) (−1.20) (−1.84) (0.83)
$R^2 = 0.99$ $F = 4941.73$

To be continued

Wage inflation (PCW) is highly sensitive to money supply expansion PCHPMS as shown in the Philips curve equation. As expected, the aggregate expenditures equation shows that AED is significantly interrelated with national income YD. In the real interest rate equation RPR, the highly significant coefficient of ERA indicated that high real interest rates are, as expected, associated with

TABLE 1 *Continued*

STRUCTURAL EQUATIONS OF THE MONETARY SECTOR

Real interest rate equation

RPR = $-25.35 + 13.90$ ERA $+ 0.00006$ DKD $+ 0.00025$ GPDID $- 0.000027$ FGSDD $- 7.2 \times 10^{-7}$ HPMS
(-3.35) (4.20) (1.29) (2.24) (-0.81) (-0.29)
$R^2 = 0.29$ $F = 3.28$

Exchange rate equation

ERA = $-0.006 + 0.0038$ RPR $+ 0.0076$ PRDD $+ 0.011$ DPRF $+ 0.0000009$ BOPD $+ 0.99$ ERAL
(-0.15) (1.81) (2.28) (2.24) (1.97) (25.52)
$R^2 = 0.97$ $F = 268.73$

Net capital outflow equation

DKD = $9667.26 - 9457.41$ ERA $- 170.14$ RPR $- 1300.07$ PRDD $- 1038.63$ DPRF $+ 0.82$ DKDL
(1.65) (-1.59) (-1.49) (-2.72) (-1.43) (9.64)
$R^2 = 0.69$ $F = 18.45$

Numbers in parentheses are t-values. Numbers in brackets are elasticities.
All value variables are deflated (1977 = 100) and in millions of U.S. dollars.

STRUCTURAL IDENTITIES

Agricultural market clearing condition

DSA = DDA + DXDA + DSKA − DSKAL

Nonagricultural market clearing condition

DSNA = DDNA − DIDNA

National income condition

YD = DDNA + DDA + DXDA − DIDNA

Balance of payments condition

BOPD = DXDA − DIDNA + DKD

Money supply condition

HPMS = FRDL + NDAD + BOPD

high real exchange rates. In short, the results in Table 1 provide support for the proposition that government budget deficits raise real interest rates which raise exchange rates which lower agricultural exports.

In conformity with conventional thought noted in the introduction, higher domestic investment GPDID and high federal budget deficits (negative of the budget surplus FGSDD) increase demand relative to supply in financial markets, hence real interest rates rise as the coefficients indicate. However, the coefficient of FGSDD although not significantly different from zero indicates that a $100 billion drop in the federal deficit reduces the real interest rate 2.7 percentage points. Similar results have been found by others but an alternative estimate based on the most recent available data and accounting for private investment, all government deficits (including state and federal deficits) relative to savings and hence perhaps the best available alternative estimate was

TABLE 1 *Continued*

DEFINITIONS FOR THE ENDOGENOUS VARIABLES	
DDNA	Domestic absorption of all nonagricultural products in millions of 1977 dollars (SCB, NIPA)
DDA	Domestic absorption of agricultural products in millions of 1977 dollars (SCB, NIPA)
DXDA	Net exports of agricultural products in millions of 1977 dollars (BS)
DIDNA	Net imports of nonagricultural products in millions of 1977 dollars (BS)
DSKA	Change in the level of inventories of agricultural products in millions of 1977 dollars (SCB, NIPA)
DSA	Production of agricultural products in millions of 1977 dollars (AS)
PCPNA	Percentage change in price index of nonagricultural products (BS)
PCW	Percentage change in index of wages in manufacturing (1977=100) (Suppl. to SCB)
AED	Aggregate expenditures in the U.S. economy in millions of 1977 dollars (SCB, NIPA)
RPR	Real prime rate of interest on short-term loans (FRB)
ERA	Index of the real exchange rate of U.S. dollars adjusted for inflation by the implicit price deflator of GNP for the U.S. and trade weighted CPI for the G-10 currencies (G-10 classification) (FRB)
DKD	Net capital outflow of capital for the U.S. economy in millions of 1977 dollars (SCB, NIPA)
PNAD	Producer price index for all nonagricultural products (1977=100) (BS)
PAD	Producer price index for all agricultural products (1977=100) (BS)
YD	National income of the U.S. economy in millions of 1977 dollars (BS)
HPMS	Supply of high powered money (M1-B) in millions of 1977 dollars (FRB)
BOPD	Balance of payments for the U.S. economy in millions of 1977 dollars (BS)
DEFINITIONS FOR THE EXOGENOUS VARIABLES	
POP	Population of the U.S. (millions) (SCB, NIPA)
YF	Foreign income indicator in millions of 1977 dollars (U.S.) (FRB)
PPF	Price index of prices paid by farmers (1910-14=100) (AS)
PCPIDNA	Percentage change in the price of nonagricultural imports (1977=100) (SCB, NIPA)
PCHPMS	Percentage change in the supply of money (FRB)
U	Percentage rate of unemployment (SCB, NIPA)
GPDID	Gross private domestic investment in millions of 1977 dollars (SCB, NIPA)
FGSDD	Federal government budget (surplus) in millions of 1977 dollars (SCB, NIPA)
PRDD	Change in the prime rate of interest on short-term loans (FRB)
DPRF	Difference between foreign and domestic interest rates (FRB)
FRDL	Foreign reserves of U.S. lagged, in millions of 1977 dollars (SCB, NIPA)
NDAD	Net domestic money assets for the U.S. in millions of 1977 dollars (SCB, NIPA)

All variables ending in 'L' are lagged values of the indicated variable.
Sources: SCB, NIPA-Survey of Current Business (National Income and Product Accounts Supplements) (U.S. Department of Commerce, 1970-1984b).
BS, Business Statistics (U.S. Department of Commerce, 1970-1984a).
AS, Agricultural Statistics (U.S. Department of Agriculture, 1970-1984).
FRB, Federal Reserve Bulletin (U.S. Federal Reserve Board, 1970-1984).

TABLE 2

Real prime rate of interest

Year/quarter	Base prediction (%)	Simulation prediction (%)	Percent difference
85/1	4.97	4.19	−15.62
85/2	5.08	4.28	−15.60
85/3	5.16	4.35	−15.58
85/4	5.22	4.40	−15.58
86/1	5.26	4.44	−15.59
86/2	5.28	4.45	−15.59
86/3	5.29	4.46	−15.61
86/4	5.28	4.46	−15.62
87/1	5.27	4.44	−15.64
87/2	5.24	4.42	−15.66
87/3	5.21	4.40	−15.69
87/4	5.18	4.36	−15.71

significantly different from zero (Tweeten, 1985, appendix). That estimate indicated that a $100 billion reduction in deficit would reduce real interest rates 2.0 percentage points. The appropriate methodology is to test for difference from the best alternative hypothesis (2.0) rather than from zero; by that test we are unable to reject the hypothesis that federal deficits raise real interest rates. The low R^2 in the real interest rate equation suggests additional work is needed to improve the specification. Thus the results in Table 1 provide support for the proposition that government budget deficits raise real interest rates which raise exchange rates which lower agricultural exports.

3. Model simulation

Estimated parameters and the economic structure from the general equilibrium model are the basis of the simulation experiments. The structural form of the model in Table 1 is represented by a set of linear structural difference equations. Forecasts are calculated from these equations based on changes in the exogenous variables only. Simulations are for the years 1985, 1986, and 1987. The results are reported from an agricultural perspective in most cases.

To gauge the impact of governmental policy actions 'Simulation Predictions' and 'Base Predictions' are contrasted in Tables 2–6. The 'Base Predictions' are made from exogenous variables which are assumed to be linear extensions of past values based on their trends from 1981 to 1984. Two notable exceptions are the federal deficit and the unemployment rate. These exogenous variables are assumed to be averages (1981–1984) because their trends imply values beyond what society would or could accept. The Simulation Predictions use

the same predetermined variable values as in the Base Prediction except for the specific policy action variables altered for the experiment. Differences between the two predictions of the endogenous variables in the model are attributed to economic policy changes.

4. Federal deficit simulation

Simulation of reduced government borrowing from the private sector is the first experiment. Not all results will be discussed in this section because the focus of this work is the economic behavior of U.S. agriculture. In this experiment the deficit is reduced to zero in the years 1985, 1986, and 1987.

When government borrowing is reduced through decreased spending, more currency is available for the private sector. Capital markets adjust to this situation by reducing the market price, which in this case is the real rate of interest. The affect of this policy action on the real prime rate of interest is given in Table 2.

For the Base Prediction, real interest rates are predicted assuming the average yearly federal deficit from 1981 through 1984, $32 billion per quarter or $128 billion annually. (The deficit for fiscal year 1985 was well above that — about $200 billion — and the impact would be correspondingly larger.) The column labeled Simulation Prediction is the model prediction based on exogenous elimination of government borrowing for the years indicated. Deficit reduction causes a stable and sustained reduction in the real prime rate of approximately 15% throughout the simulation period. The effect of government deficit reduction alone is approximately a 1 percentage point lowering of the real interest rate. The reduction would have been nearly two percentage points if the 1985 federal deficit had been utilized.

Deficit reduction translates into lower exchange rates for U.S. dollars (Table 3). The simulation exercise assumes that the supply of money is held constant in real terms. Therefore changes in the real rate of return on capital influence financial markets through changes in the demand for particular currencies. The time path of adjustment reveals that at least 1 year of reduced deficit spending is needed to achieve a 3% decrease in the exchange rate.

Domestic consumption of farm products has consistently been shown to be very price and income inelastic. Thus changes in the farming economy depend heavily on an export market which has more macroeconomic variability than does the domestic market. Macroeconomic factors affect the export market directly through the exchange rate. Reduced federal deficits reduce real rates of interest which lower the exchange rate which lowers the foreign cost of exports. The simulation results in Tables 3 and 4 support this line of thought.

As the exchange rate falls by 4% in later years, net exports climb over 6% above the level predicted without deficit reduction. An interesting aspect of the base simulation is that exports decline in the near future based on momen-

TABLE 3

Exchange rate of U.S. dollars inflation adjusted

Year/quarter	Base prediction	Simulation prediction	Percent difference
	(Index 1973 = 1.00)		
85/1	1.155	1.141	−1.21
85/2	1.174	1.141	−2.43
85/3	1.181	1.163	−1.52
85/4	1.193	1.168	−2.09
86/1	1.206	1.169	−3.06
86/2	1.213	1.174	−3.21
86/3	1.218	1.182	−2.95
86/4	1.224	1.187	−3.02
87/1	1.226	1.181	−3.67
87/2	1.225	1.180	−3.66
87/3	1.226	1.180	−3.73
87/4	1.226	1.179	−3.75

tum of conditions which existed from 1981 to 1984. A reduction in the federal deficit slows the decline in exports shown in Table 4, but does not reverse the trend.

Prices of agricultural products are represented by the index of all prices received in the sector. Competition in international markets is quick to react to

TABLE 4

Net exports of agricultural products

Year/quarter	Base prediction	Simulation prediction	Percent difference
	(millions of 1977 U.S. dollars quarterly)		
85/1	1587	1594	0.44
85/2	1493	1510	1.11
85/3	1415	1440	1.85
85/4	1349	1384	2.58
86/1	1296	1338	3.25
86/2	1253	1302	3.85
86/3	1219	1233	4.36
86/4	1193	1250	4.77
87/1	1174	1234	5.10
87/2	1161	1223	5.34
87/3	1153	1216	5.50
87/4	1149	1213	5.58

TABLE 5

Exchange rate of U.S. dollars inflation adjusted

Year/quarter	Base prediction	Simulation prediction	Percent difference
	(Index 1973 = 1.00)		
85/1	1.155	1.119	−3.07
85/2	1.174	1.107	−5.72
85/3	1.181	1.086	−8.05
85/4	1.193	1.072	−10.11
86/1	1.206	1.062	−11.95
86/2	1.213	1.048	−13.61
86/3	1.218	1.034	−15.12
86/4	1.224	1.022	−16.50
87/1	1.226	1.020	−16.80
87/2	1.225	1.016	−17.06
87/3	1.226	1.017	−17.04
87/4	1.226	1.017	−17.04

rising agricultural export prices. Prices are hypothesized to move toward some long-run equilibrium. The simulation experiment resulted in a small increase in agricultural price; less than 2% in later years. Overall the deficit reduction experiment revealed the expected changes suggested by macroeconomic theory. The increase is restrained by the high level of world commodity stocks.

5. Exchange rate simulation

The federal deficit is an important but by no means sole instrument of macroeconomic policy. A simulation experiment was undertaken to estimate the impact of more optimal overall federal economic policies. The subjective term "optimal" can mean different things to different people. Here we arbitrarily assume that more optimal macroeconomic policies are a zero difference between foreign and domestic interest rates, a real rate of interest of 4%, a zero balance of payment position, and a balanced federal budget.

Table 5 contains values of the exchange rate which is the index of ten currencies relative to the dollar with a 1973 base. Furthermore, the values have been deflated for price level increases in the U.S. and for the ten currencies (G-10 classification of the ten largest U.S. trading partners). The dynamics of the model reveal only a small initial decrease in the simulated compared to base exchange rate. But as the hypothesized economic conditions become entrenched, the simulation predictions level off at approximately 1.02. This is about a 17% decrease from what it would have been if the current situation were continued. If the 'current' situation would have contained a deficit as

TABLE 6

Net exports of agriculture products

Year/quarter	Base prediction	Simulation prediction	Percent difference
	(millions of 1977 U.S. dollars quarterly)		
85/1	1587	1594	0.44
85/2	1493	1623	8.71
85/3	1415	1647	16.39
85/4	1349	1751	29.70
86/1	1296	1832	41.35
86/2	1253	1871	49.32
86/3	1219	1898	55.70
86/4	1193	1943	62.86
87/1	1174	1989	65.55
87/2	1161	2021	74.07
87/3	1153	2033	76.32
87/4	1149	2062	79.46

large as that in 1985, the real exchange rate would have fallen considerably more in the experiment.

A comparison of this experiment with the one pertaining to federal deficit reduction alone reveals a much lower exchange rate than can be attributed solely to the deficit. Those other factors listed earlier for this scenario reflect a monetary-fiscal policy which reduces the demand for dollars in exchange markets. Other such policies could result in the desired changes, but most would require a marked slowdown in economic growth.

Agriculture in the U.S. would benefit from a lower exchange value of the dollar. It would become more competitive in world markets as incentives rise to import agricultural products. Net exports of agricultural products reported in Table 6 increase dramatically in the simulation experiment. Differences are pronounced comparing the simulation prediction to the basic model prediction. In the base case, exports decrease; in the simulation prediction, exports increase.

The results of this simulation experiment are quite different for the overall economy than for agriculture. Aggregatre expenditures in the economy drop by approximately 3% while national income falls by about half that amount. Prices of nonagricultural goods fall by 4% in the fourth quarter of 1987. The flow of capital into the country is reduced by 24% initially and by 62% at the end of the simulation period. The slowdown in capital inflow is the direct result of simulated changes in the real rate of return on capital. Other decreases come about indirectly. The implications of increasing exports and decreasing imports at any cost are clear. To do so would likely entail a recession. Any remedy

that avoids the large social costs of recession would take time to make the adjustment and a degree of fine-tuning of macroeconomic policy perhaps beyond current capabilities.

Summary and conclusions

The econometric model was used to address the objectives and form the basis of the simulation experiments measuring the impact of macroeconomic policies on the U.S. farm sector.

The first hypothesis of this study proposed that an increase in the federal deficit increases the real interest rate. According to the structural equations and the simulation results, a positive relationship exists between the deficit and the real interest rate. Simulation results indicate a smaller effect from deficit reduction than the structural equation of the real interest rate would indicate. This result stems from the interrelationships with the monetary sector. In the simulation, a fall in the real interest rate reduces capital inflows and the real exchange rate. The reduction in available funds tends to reduce the fall in real interest rates dictated by lower federal deficits. Results of this study provide no basis to reject the null hypothesis that a $100 billion reduction in the full-employment deficit reduces real interest rates 2 percentage points.

In a recent study, Tweeten (1985, appendix) found a statistically significant association between interest rates and the government deficits. On average "... elimination of the deficit could subtract approximately 4 percentage points from nominal interest rates when inflation and other variables are held constant" (Tweeten, p. 108). The implied 2 percentage point reduction in real interest rate per $100 billion drop in the full-employment government deficit is less than the 2.7 percentage point reduction found in this study but the two estimates are not statistically different.

The second hypothesis was that an increase in the real interest rate increases the real value of the U.S. dollar in foreign exchange markets. The structural equations indicate that the real interest rate has a significant positive relationship with the real exchange rate. The federal deficit simulation experiment indicated that a decrease in the real interest rate reduces the real exchange rate. The results provide support for the converse which is equally valid for our hypothesis. We are unable to reject the hypothesis that an increase in the real interest rate increases the real value of the U.S. dollar. Moreover, the evidence indicates a strong positive relationship between real interest rates and real exchange rates.

The third hypothesis was that a rise in the real value of the dollar reduces net exports of U.S. farm products. The real exchange rate variable in the export-import (net export) equation has a significant negative relationship. This indicates that net exports fall as the exchange value of the dollar rises. Exchange rate simulation was based on an 'optimal' combination of fiscal and

monetary policies. The simulation experiment revealed a decrease in the exchange rate based on the preferred combination of policies. Net exports increased as a result of the decrease in the real exchange rate. Given symmetry of the system for rising and falling values, we are unable to reject the hypothesis that an increase in the value of the dollar reduces net exports of U.S. farm products.

The conventional economic thought stated in the introduction is supported by the analysis in this paper. Evidence indicates that macroeconomic factors effect the international competitiveness of U.S. agriculture. Most of these factors are directly controlled by the federal government. The most important factor is the federal deficit and its effect on the real exchange rate through real interest rates. Money supply, which is controlled by the Federal Reserve Bank, seems to have an impact but not as much as fiscal policy of the federal government. A factor outside the direct control of the government, foreign income, has a significant effect on net exports of agricultural products. However, it is indirectly affected by the governmental policies which determine the health of the U.S. economy and its demand for foreign imports.

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