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SIMULATING FARM SECTOR OUTCOMES UNDER VARYING FINANCIAL MARKET CONDITIONS

by

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Introduction

Gibson has shown recently [3] that the level of market yields on short and long-term government securities is influenced by the expected rate of inflation. They are also affected by the use of monetary policy to check inflation. However, yields on marketable securities affect the cost and supply of loan funds to the farm sector and the financial position of its participants as well. In this paper we present and test for significance the linkages between the financial and farm sectors of our Nation's economy. We then use these linkages to ascertain the effect on the aggregate financial structure of the farm sector of changes in market yields on short and long-term government securities.

During the 1948-54 period, less than 12 percent of cash flows of capital in the farm labor sector were financed by the net flows of loan funds (see Figure 1) [8]. By 1972, this percentage had climbed to 42. It is increasingly important to be aware of the financial linkages which affect market interest rates and the portfolio balance (asset and debt structure) achieved in the farm sector. Increased reliance on external finance is diminishing some of the financial differences between the farm and nonfarm business sectors.

Financial outcomes from alternative financial market yields and the associated farm costs of loan funds affect the economic well-being of farm units in several ways. The desired asset and debt structure at the end of the year and the corresponding structure of funds flows during

1/ Views presented are the authors' and do not necessarily represent those of the U.S. Department of Agriculture.

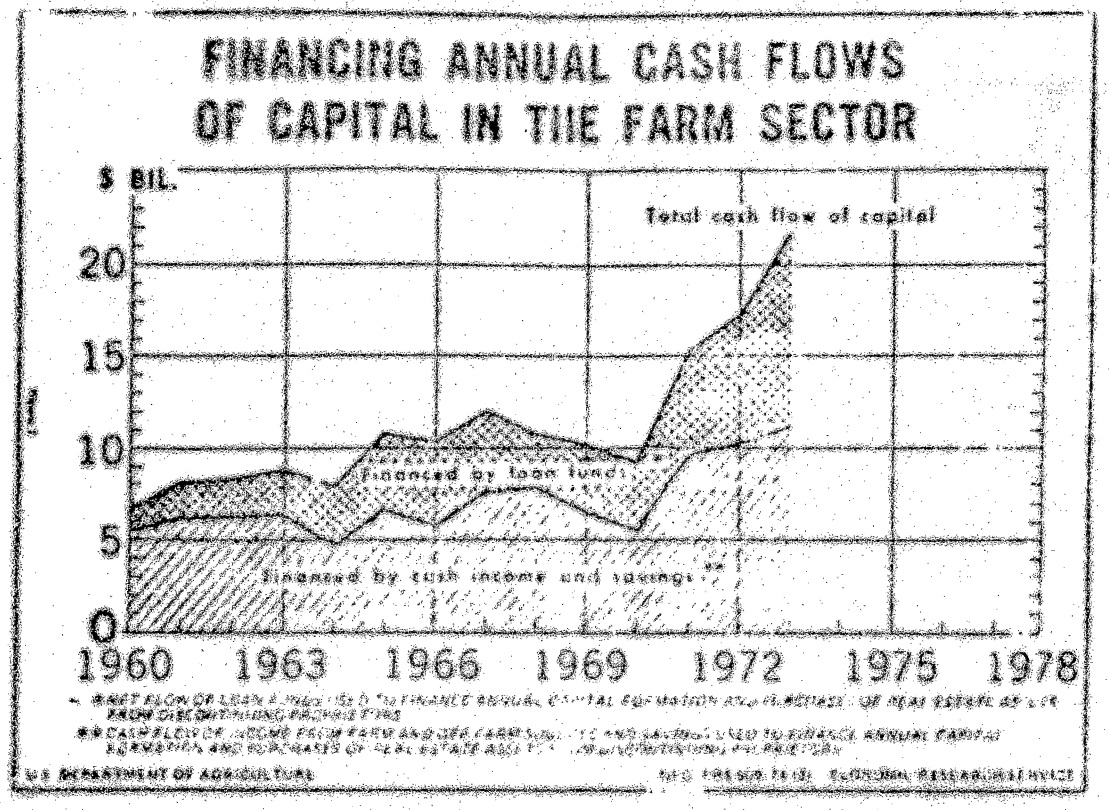

Figure 1

the year affect the level of nonpecuniary service flows during the year. Tobin [10], Hamburger [4], and Hammer [5], for example, argue that the financial position of economic units depends, in part, upon the flow of disposal liquidity provided by financial assets and inventories. In addition, Baker [1] and Penson [7] suggest that farmers take account of flows of liquidity provided by unused credit reserves when balancing their investment portfolios.

With regard to pecuniary flows, Carlin and Reinsel [2] argue that the economic welfare of farm units is determined not only by net income flows but also by the accumulation of wealth over time. Indeed inflation expectations may heighten the utility of this component of economic

welfare. Thus, it is important that alternative financial outcomes reflect the farm sector's total economic well-being: both income flows and wealth accumulations, as well as nonpecuniary flows.

Critique of Current Models

Ray and Heady [9] have designed an econometric model to estimate the effects of Federal farm programs on farm sector output, income, and capital stocks. Melichar [6] has designed another to project year-end stocks of farm sector assets and corresponding flows of capital during the year. Melichar's model computes year-end debt and the net flow of loan funds during the year residually, by subtracting the level of farm income assumed to finance capital flows from the total capital flow during the year.

Both models fail to link the farm sector to financial markets. The Ray-Heady model, for example, projects the levels of capital stocks over time without accounting for the effect that farm income flows will have upon the demand for loan funds to finance corresponding capital flows. It ignores the possibility of substituting loan funds for income as a source of financing, despite increasing reliance on loan funds, as shown in Figure 1.

The Melichar model for the farm financial market computes loan funds used to finance annual flows of capital residually, thus ignoring the linkages to financial markets. For example, the effect of a change in market interest rates cannot be traced through to the flow of loan funds and capital in the Melichar model.

Financial Component of the Aggregate Income and Wealth Simulator

Results reported in this article were obtained with a simulator [8] that contains 27 simultaneous portfolio balancing equations for the farm sector and over 30 recursive ancillary equations describing the financial and economic environment of the farm sector. Of these equations, 6 ancillary equations and 2 portfolio balancing equations constitute the financial component of the simulator. Empirical estimates of the ancillary equations are reported below in equations (1) through (6); estimates of the portfolio balancing equations, in equations (7) and (8) (Table 1).

Equations (1) through (4) are patterned after equations in the financial block of the Federal Reserve-MIT econometric model. Equation (1) was estimated by ordinary least squares regression. Equations (2) through (6) were estimated with the recursive least squares regression technique. In most cases, the coefficients differ significantly from zero at the one percent level and show the expected sign.[2/] Equations (7) and (8) were estimated by applying the two stage-principal components regression technique, to conserve degrees of freedom. In large models, such as the AIW simulator, the number of independent variables in the first stage regression can approach or exceed the number of observations in the sample.

All coefficients differ significantly from zero at the 20 percent level or less. Most were significant at the 10 percent level or less. Equations (7) and (8) permit us to accept the hypothesis that actual debt is adjusted to conform to long run equilibrium. The amount of one-year adjustment to a disequilibrating shock is measured by one minus

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2/ Four asterisks denote significance at the one percent level; three asterisks, the five percent level; two asterisks, the ten percent level; and one asterisk, the twenty percent level.

Table 1.--Equations comprising the financial components of the ATW simulator.

Equation	R^2	D-W	S.E.
(1) $r_{CPt} = .3916 + \underset{(.0261)}{\overset{****}{1.0729}}\ r_{TBt}$	.991	1.70	.181
(2) $r_{Aaat} = -.0129 + \underset{(.0462)}{\overset{****}{.3523}}\ r_{CPt} + \underset{(.0713)}{\overset{****}{.8210}}\ r_{MBt-1}$	.986	2.23	.191
(3) $r_{Mlt} = .4251 + \underset{(.3282)}{\overset{***}{.6955}}\ r_{Aaat} - \underset{(.1775)}{\overset{****}{.4727}}\ Ycd_{t-1} + \underset{(.1331)}{\overset{****}{.8306}}\ r_{Mlt-1}$	.922		.091
(4) $\log r_{TDt} = .4036 + \underset{(.1283)}{\overset{****}{.3278}} \log r_{Aaat} + \underset{(.1563)}{\overset{***}{.1488}} \log Maxr_{TDt} + \underset{(.1883)}{\overset{****}{1.4330}} \log L/A_{t-1}$	.988	1.40	.029
(5) $i_{redt} = -1.725 + \underset{(.1754)}{\overset{****}{.5515}}\ i_{ardt-1} + \underset{(.0923)}{\overset{****}{.8822}}\ r_{MNt}$	.972	1.40	.215
(6) $i_{ardt} = 6.167 + \underset{(.0309)}{\overset{****}{.436}}\ i_{redt} + \underset{(.151)}{\overset{***}{.226}}\ (R_{TB}/R_{TD})_t$	.931	1.37	.151
(7) $\$debt_{ardt} = .0210 - \underset{(.0052)}{\overset{**}{.0071}}\ i_{ardt} + \underset{(.0035)}{\overset{***}{.0069}}\ i_{redt} + \underset{(.1473)}{\overset{****}{.4066}}\ [Ipa_{mvt} + Ipa_{cpt} + Ipa_{lvt} + Ipa_{hft}]$ $- \underset{(.0705)}{\overset{*}{.0720}}\ NY_{t-1} + \underset{(.0620)}{\overset{****}{.9388}}\ \$debt_{ardt-1}$			
(8) $\$debt_{redt} = .0083 - \underset{(.0021)}{\overset{**}{.0037}}\ i_{redt} + \underset{(.0061)}{\overset{***}{.0131}}\ [Ipa_{trant} + Ipa_{lbt} + Ipa_{hdt}] - \underset{(.0547)}{\overset{*}{.0577}}\ NY_{t-1}$ $+ \underset{(.0328)}{\overset{****}{.8569}}\ \$debt_{redt-1}$			

Where:

r_{CPt} = interest yield on 4-6 month prime commercial paper in time period t,

r_{TBt} = interest yield on 3 month Treasury Bills in time period t,

r_{Aaat} = interest yield on Aaa corporate bonds in time period t,

r_{MBt} = interest yield on long-term Treasury Bonds in time period t,

r_{TDt} = interest yield on time and savings deposits at insured commercial banks in time period t,

$Maxr_{TDt}$ = maximum interest yield payable on time and savings deposits at insured commercial banks in time period t,

L/A_{t-1} = ratio of volume of farm and nonfarm debt outstanding at country commercial banks at the beginning of the year to the volume of deposits other than those required by the Federal Reserve System at country commercial banks at the beginning of the year,

r_{Mlt} = dividend yield on common stock in time period t,

Ycd_{t-1} = level of corporate profits in the previous year,

$\$debt_{redt}$ = stock of real estate secured debt outstanding at the end of the year,

$\$debt_{ardt}$ = stock of debt outstanding not secured by real estate at the end of the year,

Ipa_{mvt} = purchases of machinery and motor vehicles during time period t,

Ipa_{cpt} = net additions to crop inventories other than those held as security for CCC nonrecourse loans during time period t,

Ipa_{lvt} = net additions to livestock inventories during time period t,

Ipa_{hft} = net additions to household inventories of furnishings and equipment during time period t,

Ipa_{lbt} = capital improvements in land and service buildings in time period t,

Ipa_{hdt} = capital improvements to household dwellings in time period t,

Ipa_{trant} = uses of funds to purchase real estate assets from discontinuing proprietors in time period t,

NY_{t-1} = level of realized net farm income in the previous time period.

the coefficient of the lagged dependent variable. The large coefficients for both non-real estate and real estate debt suggest that one-year adjustments are relatively small.

Equations (1) through (6) are solved in the AIW simulator prior to solution of a system of simultaneous portfolio balancing equations. Other ancillary equations in the AIW simulator account for income and expense flows as well as other flows of funds exogenous to the portfolio balancing equations. In addition to equations (7) and (8), the system of simultaneous equations contains equations for specific desired year-end stocks of physical and financial assets and corresponding capital flows during the year.

Simulations

The financial component of the AIW simulator contains policy related variables which allow for simulations to determine the effects of monetary shocks on farmer borrowing and investment behavior. The shocks can range from changes in r_{TB} and r_{MB} (either through policy actions of the Federal Reserve System or inflation expectations) to changes in L/A (from reserve requirements) and $maxr_{TD}$ (from Regulation Q, imposing ceilings on interest rates payable on time and savings deposits at commercial banks). We will focus on the relationship between inflation and r_{TB} and r_{MB} and the resultant financial outcomes in the farm sector. Actual inflation rates are reflected in the shocks. Gibson's evidence suggests a high correlation between expected and actual rates of inflation from 1959 to 1972.

The AIW simulator was solved twice over the period, 1971-73. In the first solution, hereafter referred to as the basic solution, r_{TB} and

r_{MB} were set at actual levels reported during 1971-73. In the second solution, hereafter referred to as the regime solution, r_{TB} and r_{MB} were set at alternative levels. The rate of inflation is the same in both runs, only the relationship between interest rates and inflation varies. Comparison of the basic and regime solutions of the AIW simulator will indicate the change in the demand for loan funds and the overall financial structure of the farm sector from the change in market interest rates.

The levels of r_{TB} and r_{MB} employed in the regime solution in this paper were determined as follows:

(9) $r_{TBt} = I_t * r_{TB\ 1967}/I_{1967}$ (t = 1971, 1972, 1973)

(10) $r_{MBt} = I_t * r_{MB\ 1967}/I_{1967}$ (t = 1971, 1972, 1973)

where I_t is the rate of inflation in time period t as measured by the percentage change in the Consumer Price Index. Thus, the market yields on government secturities are assumed to increase proportionately with the rate of inflation. The base year of 1967 is a recent and commonly used base for index series and represents a year in which the rate of inflation approximated the post WW-II average. A comparison of market interest rates in the basic and regime solutions are presented in Table 2.

Regime values for R_{TB} calculated from equation (9) were higher in each year than the actual rates used in the basic solution. Regime values for R_{MB} were substantially higher in 1971 and 1973 than the actual levels recorded. The substantial difference between basic and regime values for R_{TB} and R_{MB} in 1973 is explained in part by the fact that the level of inflation in 1973 exceeded most people's expectations. Interest rates on farm real estate and nonreal estate loans for both the basic and

Table 2.--Interest rates and yields on financial investments for basic and regime solutions of the AIW simulator.

Time	Yield on 3-month Treasury bills (R_{TB})		Yield on 3- to 5-year government Bonds (R_{MB})		Interest on farm real estate loans		Interest on non-real estate farm loans	
	Basic	Regime	Basic	Regime	Basic	Regime	Basic	Regime
	Percent							
1971	4.33	6.36	5.74	7.19	7.97	9.25	7.84	8.49
1972	4.07	4.88	5.63	5.51	7.56	7.82	7.64	7.77
1973	6.91	9.31	6.29	10.50	8.03	11.82	7.95	9.70

regime solutions are determined by equations outlined earlier. The structural relationship is such that long-term rates are estimated to be higher in each year than short-term rates.

Income and Wealth

Table 3 outlines income and balance sheet statements estimated by the basic and regime solutions. The estimated value of real estate assets was over 13 percent lower in the regime solution, reflecting a decline in capitalized value. Likewise, the value of machinery and motor vehicles was reduced by over 3 percent in the regime solution.

Crop and livestock inventories were over 11 percent higher in the regime solution. This results partially from a higher price at which inventories are valued, but more importantly it reflects a substitution of inventories for financial assets as a source of liquidity. Financial assets dropped by over 31 percent in the regime solution. Higher yields on government securities drew funds from demand deposits and time and savings accounts of farm operators.

Real estate debt outstanding January 1, 1974 was over 15 percent lower under the regime solution. Higher interest rates and the lower value of land are mainly responsible for this result. However, there is also some substitution of short term debt for long term debt as a result of the more favorable interest rates available on nonreal estate loan funds. Nonreal estate debt was estimated to be only 2.4 percent lower under the regime solution. Net worth was over 9 percent lower under the regime solution.

Because of decreased production and the inelastic demand for farm products, cash receipts from marketings were slightly higher and

Table 3.--Estimated Income and Balance Sheet Items for Alternative Solutions of the AIW Simulator, 1971-73.

	Basic	Regime	Percent of total: Basic solution	Percent of total: Regime solution
	billion dollars			
January 1, 1974:				
Physical assets				
Real estate	307.4	265.1	69.1	65.9
Nonreal estate				
Machinery and motor vehicles	43.5	42.0	9.8	10.4
Crop and livestock inventory	65.2	72.6	14.7	18.1
Household furnishings and equipment	12.6	11.6	2.8	2.9
Financial assets	15.9	10.9	3.6	2.7
TOTAL ASSETS	444.6	402.2	100.0	100.0
Liabilities				
Real estate debt	39.9	33.8	9.0	8.4
Nonreal estate debt	41.6	40.6	9.4	10.1
Net worth	363.1	327.8	81.6	81.5
TOTAL LIABILITIES AND NET WORTH	444.6	402.2	100.0	100.0
During 1973:				
Cash receipts from farm marketings	84.1	85.1		
Government payments	2.6	2.6		
TOTAL CASH RECEIPTS	86.7	87.7		
Cash farm operating expenses including hired labor	43.6	43.2		
Property taxes	4.0	3.6		
Interest on debt	5.1	5.8		
Gross farm operating expenses	52.7	52.6		
NET CASH FARM INCOME	34.0	35.1		
Analytical Ratios:				
Debt-to-equity ratio	22.4	22.7		
Ratio of net cash farm income-to-total debt outstanding	41.7	47.1		

operating expenses were slightly lower in the regime solution. Property taxes decreased while interest on debt increased substantially. Net cash farm income was 3.2 percent higher in the regime solution.

While the debt-to-equity ratio remained virtually unchanged, the ratio of net cash farm income-to-total debt outstanding increased from 41.7 in the basic solution to 47.1 in the regime solution. Consequently, the ability of farm operators to retire their outstanding debt is higher under the regime solution.

Financing Capital Formation and Real Estate Transfers

The regime solution reduced capital formation in each category (Table 4) The largest percentage decline was in cash balances. Purchases of real estate assets were $2 billion lower in the regime solution. The total cash flow of capital was 16 percent lower.

Income, savings and external equity capital financed 54.2 percent of cash flow for the basic solution, but 63.4 percent for the regime solution. The net flow of real estate loans financed 21.9 percent of the cash flow in the basic solution, but only 10.7 percent in the regime solution. Despite the drop in total nonreal estate loans, they financed a larger proportion of total cash flow in the regime solution than in the basic solution: 25.9 percent and 23.9 percent, respectively.

SUMMARY

The increased interest rates of Table 1 are associated with a slight increase in net cash income to the farm sector. However, this increase was countered by dramatic portfolio effects for the sector as a whole. Net worth was reduced by 9.5 percent and startling changes occurred in

Table 4.--Cash Sources and Uses of Funds from Alternative Solutions of the AIW Simulator: Cummulative totals, 1971-1973.

	billion dollars		Percent of total	
	Basic solution	Regime solution	Basic solution	Regime solution
Cash uses of funds:				
Purchase of real estate from discontinuing proprietors	25.2	23.1	52.9	57.6
Purchase of machinery and motor vehicles	16.1	14.8	33.8	36.9
Net addition to cash balances	1.8	-1.2	3.8	-3.0
Other a/	4.5	3.5	9.5	8.5
Total uses	47.6	40.1	100.0	100.0
Cash sources of funds:				
Internal b/	25.8	25.4	54.2	63.4
Net flow of loans c/				
Real estate	10.4	4.3	21.9	10.7
Nonreal estate	11.4	10.4	23.9	25.9
Total sources	47.6	40.1	100.0	100.0

a/ Includes net additions to household furnishings and equipment; capital improvements to household dwellings, land, and service buildings; and net additions to farm inventories.

b/ Current income and savings plus proceeds from sector sales of equity instruments.

c/ It is assumed that all net increases in loan funds are used for the items listed under uses of funds.

the structure of capital flows. Despite a substantial decline in the volume of funds for purchase of real estate, the percentage of total cash flows used for this purpose increased to 57.6 from 52.9. Purchases of machinery and motor vehicles responded similarly. Meanwhile there was an actual decline in cash balances. Hence, there clearly was an increase in the proportion of assets held in a less liquid form.

Liquidity was also affected by changes in sources of funds. The percentage financed from internal sources increased substantially, as the percent financed with loans declined. But the sharpest change was in the structure of loan flows: a large reduction in the percent of capital flows financed with real estate loans, and an increase in the percent of total capital flows financed by nonreal estate loans. The resulting decline in liquidity of sector assets must be weighed against the slight increase in net cash income. Indeed the reduced balance sheet liquidity must surely heighten the cost of risk management, especially given the added cash costs associated with inflation and the increased uncertainty of inflation-fed prices received. But here we have stepped beyond the bounds permitted by the AIW simulator. It would also be useful to say something on the distribution of financial outcomes among regions and among size and tenure classes of farms. But this too must await further research and development.

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