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A SIMULATION OF FARM SECTOR SOCIAL ACCOUNTS WITH PROJECTIONS TO 1980
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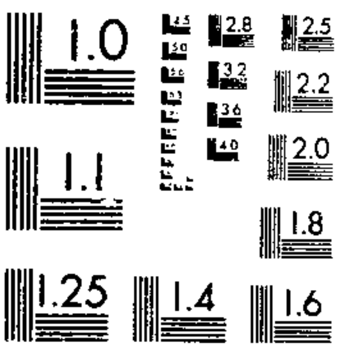

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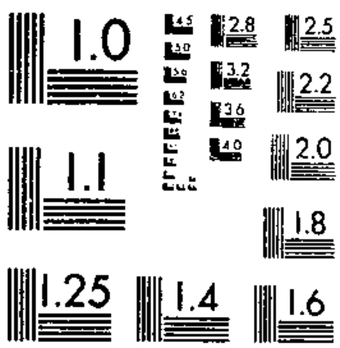

MICROCOPY RESOLUTION TEST CHART
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A SIMULATION MODEL OF FARM SECTOR SOCIAL ACCOUNTS

With Projections to 1980

TECHNICAL BULLETIN NO. 1486 • ECONOMIC RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

ABSTRACT

A simulation model developed from regression estimates of farm sector sources and uses of funds is used to project a farm income statement, balance sheet, and sources-and-uses-of-funds statement to 1980. Projection results suggest that (a) total assets in the farm sector may total more than $450 billion by 1980, (b) real estate debt may grow much more slowly than nonreal estate debt, (c) proprietors' equities as a percentage of total assets may decline from 81.2 percent in 1970 to 73.5 percent in 1980, and (d) total funds from all sources for the farm sector in 1980 may be 58 percent greater than in 1970.

The simulation model is also used to appraise the impact on financial structure of selected public policies. Results suggest that (a) lowering reserve requirements on deposits as suggested by the President's Commission on Financial Structure and Regulation would have little impact on lending in the farm sector, and (b) the imposition of minimum wage rates for all hired farmworkers would reduce net income of farm operators, decrease consumption levels of farm operators, and substantially increase the demand for farm machinery and nonreal estate debt, but result in only a slight decline in proprietors' equities.

Keywords: Flow of funds, balance sheet, income statement, simulation, models, simultaneous equations, projections, policy implications.

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SUMMARY

Farm real estate assets of over $315 billion by 1980, an increase of 51 percent over the 1970 level, are projected by use of a simulation model. In addition, real estate assets are projected to account for an increasing share of the value of all assets in the farm sector.

Farm real estate debt is projected to be $48.5 billion by 1980, an increase of over 59 percent. Nonreal estate debt, at $71.9 billion, would be 142 percent higher than in 1970.

Proprietors' equities are projected to be $335 billion by 1980, an increase of 33 percent. However, proprietors' equities as a percentage of total assets are projected to decline from 81.2 percent in 1970 to 73.5 percent in 1980. A residual rate of return on equity in real estate assets below the 1970 level is projected.

Net farm income for 1980 is projected to be only 8.1 percent higher than the 1970 level. However, total funds from all sources in the farming sector are projected to increase roughly 58 percent over the same period.

Alteration of key assumptions underlying the projections suggested that a constant parity ratio over time (at the 1971 level) would yield substantially higher projected levels of net farm income and proprietors' equities, while projected income from nonfarm sources would decline. Projected farm real estate debt would increase slightly and nonreal estate debt would decline slightly. Both real estate and nonreal estate assets would be higher.

Other simulation results suggested that a lower level of inflation (in both prices received and prices paid by farmers) would have little influence on financial structure of the farm sector. Projected net farm income would be virtually unaffected. The projected value of real estate assets would be lower. Proprietors' equities would, however, increase slightly. Total sources of funds and proprietor withdrawals would be virtually unaffected.

The simulation model of farm sector social accounts was written in FORTRAN programming language. Validation tests indicated that the model gave accurate estimates for the farm income and balance sheet accounts. The sources-and-uses-of-funds statement generated by the model indicated that aggregate net change items were more accurately estimated than disaggregated net change items. It was concluded that the model was sufficiently accurate to warrant application to policy and predictive questions concerning financial structure of the farm sector.

The model was constructed from results of a comprehensive set of functional equations, which were developed to determine interactions among farm sector sources and uses of funds and related exogenous variables. Regression analysis was used to test the empirical validity of hypothesized relationships. The results of these regression estimates suggest that:

(1) With a series of nine equations, and taking Government payments to farmers as given, estimates of net farm income can be obtained which differ little from empirical estimates published regularly by the U.S. Department of Agriculture.

(2) Most variation over time in per capita nonfarm income of the farm population can be explained by the spread between farm and nonfarm earnings, the man-hours of operator and family labor used in farming, and the rate of unemployment in the U.S. economy.

(3) Simultaneously estimated supply and demand equations can explain a significant portion of the net variation in farm real estate and nonreal estate debt.

(4) A significant portion of the annual variation in capital appreciation of farm real estate assets can be explained by the interest rate on new real estate loans, changes in prices received and prices paid by farmers, and the quantity of land in farms. It was also shown that quite accurate estimates of the stock of farm real estate assets can be obtained by adding the estimated levels of capital improvements and capital appreciation to the stock of real estate assets at the start of the period.

Application of the simulation model to appraise selected public policies suggested that lowering reserve requirements on demand deposits and time and savings deposits as suggested by the President's Commission on Financial Structure and Regulation would have very little impact on the farm sector. The probable impact would be only a slight increase in both farm real estate and nonreal estate debt owed to commercial banks.

The imposition of minimum wage legislation for hired farm laborers would reduce the net farm income of farm operators. This loss of income would be offset by higher levels of nonfarm income and lower levels of proprietor withdrawals. Real estate debt would decrease slightly while nonreal estate debt would increase substantially. The value of farm machinery and equipment would also increase substantially to offset the decline in the use of hired labor. Proprietors' equities would decline only slightly as a result of the imposition of minimum wage legislation.

A SIMULATION MODEL OF FARM SECTOR SOCIAL ACCOUNTS
With Projections to 1980

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INTRODUCTION

Many policy, behavioral, and predictive questions require economists to relate income streams, noncash flows of capital, and balance sheet items. Existing aggregate social accounts provide much of the needed economic intelligence relating to financial dimensions of national or regional aggregates. However, existing social accounts do not necessarily reveal the underlying functional relationships among sources and uses of funds and balance sheet components.

Initial results from an ongoing research program focusing on identifying those factors which significantly influence changes in the financial structure of the farm sector are presented in this report. Further efforts are underway to improve the equations and simulation model reported herein. A concurrent study by Penson (*18*)[1] is also directed toward this area of research. Results are presented at this time to indicate the progress and to encourage wider participation in research of this nature.

Currently there are three social accounts which are used in evaluating financial structure of the farm sector. The National Economic Analysis Division, Economic Research Service, U.S. Department of Agriculture, maintains a series (*28*) known as the Balance Sheet of the Farming Sector (BSFS) which depicts resources in the farm sector and claims on these resources, plus specific off-farm accounts of farm operators.[2] The BSFS shows the *stock* of assets and liabilities at a given time and the net change of these stocks between periods. The National Economic Analysis Division also maintains series on farm income and expenditures which are reported in the Farm Income Situation (FIS) (*30*). The magnitude and types of income and expenditure flows provide an additional measure of financial structure. But not all resulting changes in stocks of assets are recorded.

The third set of social accounts, flow-of-funds (FOF) accounts, is derived directly from a combination of balance sheet and income items. Ritter (*24*) states that, as one of the more recently developed social accounting systems, "The flow-of-funds accounts . . . are as indispensable for understanding developments and interrelationships in financial markets as the national income accounts are for understanding trends in production and real output." To construct flow-of-funds accounts one divides the economy into sectors; develops a sources-and-uses-of-funds (SAUF) statement for each sector; and places them side by side to get an FOF matrix. The Federal Reserve Board (FRB) includes, but does not publish separately, a "farm business sector" SAUF account in its national FOF accounts. Due to conventions adopted in construction of the national FOF accounts, the FRB "farm business sector" SAUF statement and existing farm sector social accounts are not internally consistent. Penson, Lins, and Irwin (*20*) have recently described these inconsistencies and have suggested an alternative farm sector SAUF account which is definitionally and conceptually consistent with existing farm income and balance sheet accounts. This account provides the starting point from which much of the following analysis originates.

OBJECTIVES

The objectives of this study are:

1. To develop a comprehensive set of equations to determine functional relationships among farm sector sources and uses of funds and related exogenous variables, with special emphasis given to estimating functional equations for sources of funds.
2. To use the results of the functional equations to construct a simulation model of farm sector social accounts which can be used to answer selected policy, behavioral, and predictive questions concerning the financial structure of the farm sector.[3]

[1] Italic numbers in parentheses indicate items in the References, p. 39.

[2] The term "farm sector" as used herein is equivalent to the concept used in constructing the BSFS. The BSFS is not a balance sheet solely of farm operators. It also includes farm assets and farm-related debt of nonfarm landlords. However, nonfarm assets and nonfarm debts of such nonfarmers are excluded. Agribusiness firms are not considered part of the farm sector.

[3] The questions of financial structure dealt with herein are concerned with the relationships among farm sector assets, liabilities, income, and noncash flows of capital, rather than the distribution of these by subgroups within the farm sector.

Table 1—Farm sector sources-and-uses-of-funds statement disaggregated by farm lending institutions, United States, 1967[1]

	Item	Value	
	Sources of funds	*Billion dollars*	
1.	Net farm income	14.8	
2.	Nonfarm income	10.9	
3.	Capital consumption	5.7	
4.	Net change in real estate debt	2.2	
	a. Federal land banks		(0.6)
	b. Life insurance companies		(0.0)
	c. Commercial banks		(0.3)
	d. Farmers Home Administration		(0.4)
	e. Individuals and other		(0.9)
5.	Net change in nonreal estate debt (excluding CCC loans)	2.5	
	a. Production credit association		(0.7)
	b. Commercial banks		(0.5)
	c. Farmers Home Administration		(0.1)
	d. Merchant-dealer, individual and other		(1.0)
6.	Capital appreciation	9.3	
	Total	45.2	
	Uses of funds		
7.	Capital expenditures on nonreal estate assets	5.2	
8.	Net change in farm inventories	0.7	
9.	Net change in financial assets	1.0	
	a. Net change in deposits and currency		(0.6)
	b. Net change in U.S. Savings Bonds		(−0.1)
	c. Net change in investments in cooperatives		(0.5)
10.	Total investment in real estate assets	10.6	
	Subtotal	17.5	
11.	Proprietor withdrawals	27.7	
	Total	45.2	

[1] Source: Lins, David A., "An Analysis of Sources and Uses of Funds in the Farm Sector of the United States," unpublished Ph.D. thesis, University of Illinois, Urbana, 1972, table 2.1.

A SOURCES-AND-USES-OF-FUNDS STATEMENT

A single SAUF statement is a component of a complete FOF account. In calculating a SAUF statement, sources of funds must equal uses of funds. However, savings of a single sector need not equal investment in that sector.

The distinction between a "cash flow account" and a SAUF statement designed for social accounting purposes has been the source of some confusion. Brake and Barry (*3*) argue that the two concepts should be essentially identical. They suggest that cash flows should be included and noncash flows of capital excluded from a SAUF statement. However, this is contrary to the manner in which the national FOF accounts are constructed. Neither approach can be considered right or wrong per se. Rather, the differences reflect divergent orientation and transaction coverages. As used in this study, a SAUF statement will include both cash flows and noncash flows of capital. The procedure follows the more commonly accepted definition of the term.

FUNCTIONAL ESTIMATES OF FARM SECTOR SOURCES AND USES OF FUNDS

Table 1 outlines a farm sector SAUF statement identical to the one proposed by Penson, Lins, and Irwin, except that it further disaggregates net changes in debt. Net changes in farm real estate and nonreal estate debt are disaggregated by lending institution to allow for a more detailed analysis of this source of funds. To the extent that it is meaningful and feasible, each source and use of funds listed in table 1 is estimated by an equation or series of equations. The order of presentation of equations follows the same order as items listed in table 1.

Time series regression analysis is used to determine the empirical validity and importance of hypothesized functional relationships. Some equations reported in the following sections are estimated by ordinary least squares. An iterative procedure described by Johnston (*10*, p. 198) is used to correct for autocorrelation when the Durbin-Watson statistic suggests its presence. Several equations to be reported later represent simultaneous systems. These equations are estimated by two-stage least squares. A more detailed description of the statistical properties of the regression techniques employed is given in (*11*).

Regression Estimates of Sources of Funds[4]

Net farm income

Net farm income is the major source of funds in the farm sector. Annual net farm income is given by:

(1.1) $NFI = GFI - GFE$

Where:

GFI = annual gross farm income,
GFE = annual gross farm expenses.

(1.2) $GFI = CRMVHC + GRV + \Delta I + GP$

Where:

CRMVHC = annual gross cash receipts from marketings plus the value of farm products consumed directly in farm households,
GRV = annual gross rental value of farm dwellings,
ΔI = annual net change in crop and livestock inventories,
GP = annual level of Government payments to farmers.

And:

(1.3) $GFE = IFRD + COE + TAX + DPNR_B + DPNR_M + ACD$

Where:

IFRD = annual interest payments by farmers on real estate debt,
COE = annual current operating expenses plus net rent to nonfarm landlords,
TAX = annual level of taxes levied on farm property,
$DPNR_B$ = annual depreciation of farm buildings and dwellings,
$DPNR_M$ = annual depreciation of farm machinery,
ACD = annual level of accidental damage to farm property.

The value of cash receipts from farm marketings plus the value of farm products consumed directly by farm households is determined by the level of farm marketings and direct consumption and the prices received for commodities marketed. The level of farm marketing and direct consumption can be measured by the index of the volume of marketings and household consumption (I_{VMHC}) while prices can be measured by the index of prices received by farmers (I_{PR}). Using data for the period 1949 to 1969, the level of cash receipts from farm marketings plus the value of farm products consumed directly in farm households (CRMVHC) was regressed against the index of the volume of marketings and household consumption multiplied by the index of prices received. Results are reported in equation (1.4) below.[5] Estimation was by ordinary least squares.

(1.4) $CRMVHC = -2942.5 + \underset{(0.076)^{***}}{4.37} (I_{VMHC} \cdot I_{PR})$

Period of fit: 1949-70
$R^2 = 0.997$ D-W = 1.41

Where:

CRMVHC = the annual level of cash receipts from farm marketings plus the value of farm products consumed directly in farm households (million dollars) (*30*),
I_{VMHC} = Index of the volume of marketings and home consumption (1967 = 100) (*30*),
I_{PR} = Index of prices received by farmers (1957-59 = 100) (*27*).

The high value of R^2 is merely an indication that multiplication of the index numbers results in an accurate estimate of income, as one would expect. The Durbin-Watson statistic (D-W) allows one to reject the hypothesis

[4] The numbering system for equations is related to the numbering system in table 1. All equations starting with 1 are involved in determining net farm income, all equations starting with 2 are involved in determining nonfarm income, etc.

[5] Items in parentheses below regression coefficients are standard errors with *** = significantly different from zero at the 1-percent level, ** = significantly different from zero at the 5-percent level, and * = significantly different from zero at the 10-percent level. This notation is used throughout. Reference numbers after the definition of variables indicate the source of data.

of autocorrelated errors. While this equation is basically an identity, it is useful to state it in terms of I_{VMHC} and I_{PR} since these are variables we may later wish to vary for simulation purposes.[6]

The estimated imputed gross rental value of farm dwellings is a small component of gross farm income. The official estimate is obtained as the sum of the estimated total sales value of farm dwellings times a mortgage interest rate, plus estimated repairs, depreciation, taxes, and insurance on the dwellings. In discussing the procedure used in deriving this estimate, Myers (*15*, p. 16) has stated that "... imputed gross rental value of farm dwellings rests on much weaker statistical foundations than most of the commodity estimates and may be subject to a considerable margin of error." Therefore, meaningful estimation of structural parameters is not possible. However, since some estimate is required to arrive at a gross farm income estimate, the lagged dependent variable was used as the "independent" variable. This procedure is similar to the approach taken by Fox (*5*). Results are reported in equation (1.5):

$$(1.5)\quad GRV = -70.1 + \underset{(0.04)^{***}}{1.067}\, GRV_{t-1}$$

Period of fit: 1949-70
$R^2 = 0.975$ D-W = 1.69

Where:

GRV = gross rental value of farm dwellings (million dollars) (*30*).

The only advantage of using this equation over taking the official estimate as given is that it explicitly indicates how strongly successive values are related and the rate at which gross rental value grows over time. The regression coefficient suggests that the imputed gross rental value has increased at the rate of approximately 6.7 percent per year. Because of the nature of the equation, little reliance can be placed on the standard error on the regression coefficient or on the Durbin-Watson statistic.

One way to estimate changes in inventories is to use a functional approach. Net changes in inventories *measured in value terms* can occur in three ways: (a) With year-end stocks of inventories unchanged, changes in average market prices will result in changes in the year-end value of inventories; (b) with price constant, the year-end level of stocks can change; and (c) both prices and the level of stocks can change. With prices constant, the level of stocks may change due to tight financial conditions which result in selling to gain funds, a natural growth of stocks due to a growing volume of business, or a depletion in stocks due to lack of adequate production. Depletion in the volume of stocks may also result from favorable prices. However, favorable prices result in a higher value for remaining inventories so that the overall impact of increased prices on inventories in value terms is hard to determine. Several alternative functional equations were tested with little success.[7]

Another method of estimating the net change in farm inventories (ΔI) is a definitional approach. The quantity of year-end stocks can be defined as the stock at start of the period plus the volume of output minus the volume of marketings. Year-end inventories in value terms are equal to the quantity of stocks multiplied by the prices at which inventories are valued. But to measure net changes rather than stocks, one needs to take the net change in the variables just described. Equation (1.6) reports the results of this equation where the volume of marketings is measured by I_{VMHC}, the volume of output by the index of farm production and output (I_{OUT}), and prices at which inventories are valued by I_{PR}:

$$(1.6)\quad \Delta I = 331.29 + \underset{(31.9)^{***}}{195.34}\,[(I_{OUT_t} - I_{VMHC_t}) - (I_{OUT_{t-1}} - I_{VMHC_{t-1}})] + \underset{(9.83)^{*}}{18.14}\,(I_{PR_t} - I_{PR_{t-1}})$$

Period of fit: 1949-70
$R^2 = 0.775$ D-W = 2.20

Where:

ΔI = annual net change in farm crop and livestock inventories (million dollars) (*30*),

I_{OUT} = index of farm production and output (1957-59 = 100) (*27*).

Results of this equation suggest that changes in inventories (measured in value terms) during 1949-69 were influenced by both quantity changes and price changes. Because of the aggregate nature of variables used, not all variation is accounted for. Assume for the moment that all production consisted of corn or wheat. Further, assume

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[6] Taking the values of I_{VMHC} and I_{PR} as exogenous indicates that there is no direct estimation of a production function or a consumer demand function.

[7] The independent variables tested in these equations included measures of prices received, production, and measures of financial conditions such as net cash income.

that for a given year, all corn is marketed, but that the storage of wheat results in an increase in the volume of inventories. $I_{OUT} - I_{VMHC}$ should fairly accurately reflect the buildup of wheat stocks. However, the I_{PR} which is based on both wheat and corn prices would not accurately value these stocks. Since a commodity-by-commodity buildup of the change in inventories is not feasible here, and because changes in inventories are a small portion of income, we shall use equation (1.6), fully recognizing its limitations.[8]

Direct Government payments to farmers are a key policy-controlled source of funds for the farm sector. To estimate the level of direct Government payment to farmers would involve an attempt to explain the behavior of policymakers. This is not the purpose of this report. Rather, direct Government payments to farmers are treated as given. Given the level of direct Government payments and using the estimates from equations (1.4) through (1.6) one can estimate gross farm income.

Production expenditures in the farm sector consist of interest on farm mortgage debt, current farm operating expenses including net rent to nonfarm landlords, and taxes on farm property. "Total farm mortgage interest charges are obtained in any calendar year by multiplying the farm mortgage debt held by each principal type of lender at the beginning of the year by the average rate of interest on the debt owed that type of lender on the same date. The sum of the resulting January 1 charges for all principal types of lenders is averaged with the corresponding sum for the beginning of the next year to obtain the total interest charges for the calendar year" (*34*, p. 26). U.S. estimates are built up from State data when possible. A close approximation to this estimate can be obtained as in equation (1.7):

$$(1.7)\quad IFRD_t = -3.90 + 1.068\,(\bar{i}_{to} \cdot RED_{to}) \quad (0.005)^{***}$$

Period of fit: 1949–69
$R^2 = 0.999$ D-W = 1.88

Where:

IFRD = annual interest charges on farm mortgage debt (million dollars) (*30*)

$\bar{i}_{to}$ = annual interest rate on farm mortgage loans outstanding at start of the year (percent) (*26*),

RED_{to} = farm real estate debt outstanding at the start of the year (million dollars) (*26*).

Current operating expenses plus net rent to nonfarm landlords (COE) was estimated as a function of the index of farm production and output (I_{OUT}) and the index of prices paid (I_{PP}). Equation (1.8) indicates that after correction for autocorrelation these variables explain 95.5 percent of the variation in COE:[9]

$$(1.8)\quad COE = -16026.2 + \underset{(35.58)^{***}}{68.82}\, I_{OUT} + \underset{(34.35)^{***}}{282.24}\, I_{PP}$$

rho = 0.5553

Period of fit: 1949–69
$R^2 = 0.955$ D-W = 1.53

Where:

COE = annual current farm operating expense plus net rent to nonfarm landlords (million dollars) (*30*),

I_{PP} = index of prices paid by farmers (Parity Index) (1957-59 = 100) (*37*).

Taxes on farm property (TAX) consist of farm real estate taxes plus personal property taxes. Because payment of taxes may occur in the year after their assessment, FIS data for farm tax expenditures represent the amount of taxes *levied* for a given year rather than the actual amount of taxes *paid* in any given year. The U.S. estimates of real estate taxes levied are derived from a mail questionnaire sent to the tax official in each county or town of each State. Estimates of personal property taxes levied are obtained by estimating the assessed values of personal property and then multiplying these figures by applicable tax rates. The procedure used here to estimate taxes is to make the level of taxes levied a function of all physical assets of the farm sector. To allow for an increasing tax rate per dollar of assets, equation (1.9A) was fitted in semilog form:[10]

$$(1.9A)\quad LTAX_t = 2.628 + \underset{(0.00014)^{***}}{.00294}\, TVPA \qquad rho = 0.6164$$

Period of fit: 1949–69
$R^2 = 0.952$ D-W = 1.47

[8] Another approach would be to estimate functionally the year-end stocks of crop and livestock inventories as measured in the BSFS. One could then take net changes in values of these items and include them as estimates of net changes in inventories. The problem with this approach is that there is a rather substantial difference between FIS and BSFS data. For example, the net change in crop and livestock inventories from 1949 through 1970 based on FIS data is roughly \$6.1 billion. BSFS data suggest that the net change in inventories over the same period is roughly \$11.4 billion.

[9] Equations which include a rho coefficient have been corrected for autocorrelation using an iterative procedure described by Johnston (*10*, p. 198). The rho coefficient is used to transform the original variables. However, after correction the constant term is adjusted so that all variables are restated in their original terms.

[10] After correction for autocorrelation, the equation estimated in semilog form gave better statistical results than equations estimated in linear or double-log form.

Where:

LTAX = log (base 10) of the annual taxes of farm property (*30*),

TVPA = total value of physical assets of the farm sector (billion dollars) (*28*).

One can convert the estimate from logs by equation (1.9B):

(1.9B) $TAX = 10^{LTAX}$

Where:

TAX = annual taxes on farm property (million dollars).

The level of depreciation of farm buildings ($DPNR_b$) is equal to the rate of depreciation multiplied by the value of the existing stock of buildings. A problem arises in measuring the value of this stock. Estimates of the value of buildings, upon which FIS makes estimates of depreciation, are not published. One can use estimates of the value of stocks as reported in BSFS or in Farm Real Estate Market Developments (FRMD), but this estimate is not identical to the estimate used by FIS. In addition, Reinsel (*23*, p. 13) points out that, "because of the nature of the farm building value estimates and the data from which they are calculated, statistical tests of significance are not applicable." In spite of all limitations of the data, it is necessary to estimate building depreciation to complete the model under construction. Therefore, the depreciation of farm buildings as reported in FIS is regressed against the value of farm buildings as reported in FRMD. Results are shown in equation (1.10):

(1.10) $DPNR_b = -1074.1 + 0.07049\,TVB$ rho = 0.6918
(0.006)***

Period of fit: 1949-69
$R^2 = 0.873$ D-W = 1.23

Where:

$DPNR_b$ = annual depreciation of farm buildings (million dollars) (*30*),

TVB = total value of farm buildings at the start of period (million dollars) (*31*).

The regression coefficient for TVB indicates an annual rate of depreciation on farm buildings of roughly 7 percent.[11] However, since the estimate of TVB developed in the BSFS is somewhat higher than the unpublished figures used in FIS, the rate of depreciation in $DPNR_b$ cannot be accurately measured with this equation. For reasons cited by Reinsel, one cannot place heavy reliance on the standard error of the regression coefficient.

The level of machinery depreciation ($DPNR_m$) is estimated separately from that of buildings because rates of depreciation on the two assets are expected to be substantially different. One can estimate the level of machinery depreciation reported in FIS as a function of the total value of machinery (TVM) in the BSFS, as shown in equation (1.11):

(1.11) $DPNR_m = 170.20 + 0.1331\,TVM$ rho = 0.65066
(0.0073)***

Period of fit: 1949-69
$R^2 = 0.964$ D-W = 1.97

Where:

$DPNR_m$ = annual depreciation of farm machinery and equipment (million dollars) (*30*),

TVM = total value of machinery and equipment (million dollars) (*28*).

Based on the results of equation (1.11), one can reject the hypothesis of autocorrelated error terms. The regression coefficient for the total value of machinery is significantly different from zero at the 1-percent level. The regression coefficient and the positive constant term indicate that the annual rate of depreciation is over 13-percent per year.

The extent of accidental damage to farm assets by fire, wind, hail, or flood in any given year is, by its very nature, subject to substantial variation. Efforts to explain the level of accidental damage are not likely to capture a major portion of the variation involved. Nonetheless, as the stock of assets grows, there is a greater potential for the value of damage to increase also. Therefore, the level of accidental damage to farm assets was regressed against the total value of farm machinery and buildings. Results are given in equation (1.12):

(1.12) $ACD = 47.17 + 0.00255\,(TVB + TVM)$
(0.0007)***

Period of fit: 1949-69
$R^2 = 0.409$ D-W = 1.70

Where:

ACD = annual level of accidental damage to farm property (million dollars) (*30*).

[11] The constant term and regression coefficient for equation (1.10) have no empirical meaning in the strictest sense because they merely link the stock of buildings reported in FRMD with the assumed depreciation rate in the FIS.

Table 2—Total net farm income as estimated by two methods, and differences between the estimates, United States, 1949–69

Year	FIS estimate[1]	Equational estimate	Difference	Error
	Million dollars	*Million dollars*	*Million dollars*	*Percent*
1949 . . .	12,780	13,164	–384	–3.0
1950 . . .	13,673	14,516	–843	–6.2
1951 . . .	15,987	17,916	–1,929	–12.1
1952 . . .	15,051	14,924	127	0.8
1953 . . .	13,088	12,048	1,040	7.9
1954 . . .	12,503	11,818	685	5.5
1955 . . .	11,464	10,806	658	5.7
1956 . . .	11,444	10,813	631	5.5
1957 . . .	11,325	10,078	1,247	11.0
1958 . . .	13,500	13,801	–301	–2.2
1959 . . .	11,454	10,783	671	5.9
1960 . . .	12,079	12,071	8	0.1
1961 . . .	12,987	12,798	189	1.5
1962 . . .	13,215	13,442	–227	–1.7
1963 . . .	13,206	13,665	–459	–3.5
1964 . . .	12,266	13,046	–780	–6.3
1965 . . .	14,987	15,077	–90	–0.6
1966 . . .	16,253	17,020	–767	–4.7
1967 . . .	14,882	14,810	72	0.5
1968 . . .	14,825	15,172	–347	–2.3
1969 . . .	16,891	16,557	334	2.0
Total . . .	283,860	284,325	–465	–0.2

[1] Source: Farm Income Situation, July 1971.

The regression coefficient is significantly different from zero at the 1-percent level, indicating that the level of accidental damage is related to the total value of farm machinery and buildings. The R^2 of 0.409 indicates that much of the variation remains unexplained.[12]

The preceding paragraphs outlined equations with which to determine the various components of net farm income. Using the equations developed, and taking the level of Government payments to farmers as given, one can estimate net farm income. Comparisons of this estimate with the estimated level of net farm income published in FIS are given in table 2.

As indicated in table 2, the estimated levels of net farm income correspond fairly well with the FIS estimates. The greatest divergence between the two estimates in both absolute and percentage terms occurred in 1951. On the average, the percentage difference in the estimates was about 4 percent. Another consideration is whether or not the equational estimates indicate the same turning points as the FIS. That is, is the direction of change (positive or negative) in net farm income the same in both estimates? In all but 3 years the direction of change was the same in both estimates. Turning points were missed when net changes in income were very small. For the 21 years covered, the equational estimate was $465 million above the FIS estimate, a difference of less than 0.2 percent.

[12] The level of accidental damage is net of insurance payments. Accidental damage occurs on machinery as well as buildings, but only a small fraction of the damage is on machinery. Using only the value of buildings as the explanatory variable, 36 percent of the variation is explained.

Nonfarm income of the farm population

Nonfarm income of the farm population has increased in recent years, both absolutely and relative to farm income of the farm population. Nonfarm income of the farm population as a percentage of farm income increased from about 30 percent in 1946 to over 93 percent in 1970. The factors that influence the changing level of nonfarm income of the farm population over time can be grouped into three broad categories: (a) changing characteristics of the farm population, (b) changing incentives for nonfarm work, and (c) changing environment in which nonfarm income is earned. In the analysis which follows, an attempt is made to explain nonfarm income of the farm population using variables that can be measured with available data.

In equation (2.1), per capita nonfarm income of the farm population is regressed against the spread between hourly earnings in the nonfarm sector and the net return per hour of operator and family farm labor, the man-hours of operator and family farm labor per operator per year, and the rate of unemployment in the U.S. economy. Expressing the dependent variable, nonfarm income of the farm population, on a per capita basis removes the influences of a changing number of people in the farm population. As the spread between hourly earnings in the nonfarm sector and the net return per hour of operator and family farm labor increases, one might expect the level of nonfarm income per capita to increase, other things equal. Likewise, as man-hours of operator and family farm labor per operator per year increase, the ability of the operator or his family to earn nonfarm income would decline. Increases in the rate of unemployment are likely to restrict nonfarm employment opportunities and thereby result in lower levels of nonfarm income.

Net return per hour of operator and family farm labor was estimated in the following manner. The imputed return to equity in real estate and nonreal estate assets was subtracted from the level of net farm income reported in FIS.[13] This gives the return to labor and management, which for simplicity is described here simply as returns to labor. The imputed return to all nonreal estate assets is published in (*26*, p. 67), and imputed return to equity in nonreal estate assets is derived by subtracting actual interest payments on nonreal estate debt from this figure. The imputed return to equity in real estate assets is the weighted average (equal weights) of the yield on time deposits and the rate of interest on new farm mortgages multiplied by the equity value of real estate assets.

Total hours of operator and family labor were obtained by subtracting estimated man-hours of hired labor from total man-hours of labor used in the farm sector. An estimation of man-hours of hired labor used on farms was obtained by dividing the level of wages and salaries paid hired labor as reported in FIS by the average hourly earnings of hired farmworkers as reported in Farm Cost Situation (*29*). Man-hours of operator and family labor per operator are simply the total man-hours of operator and family labor divided by the number of farm operators. This definition includes man-hours of operator and family labor of nonresident farm operators. Conceptually one would like to exclude this source of labor in calculating man-hours of operator and family labor per resident operator. To the author's knowledge, existing data series are not adequate for this calculation.

[13] Under this approach, capital appreciation of assets is not included in returns to be imputed.

$$(2.1)\quad PNNFI = 1989.8 + \underset{(82.81)^{***}}{267.86}\,(AHWR - OLR) - \underset{(0.191)^{***}}{0.798}\,MHOL - \underset{(22.32)^{***}}{65.60}\,U \qquad rho = 0.273$$

Period of fit: 1949-69

$R^2 = 0.88$ D-W = 1.65

Where:

PNNFI = per capita income of the farm population from nonfarm sources (dollars) (*30*),

AHWR = average hourly earnings of nonsupervisory employees on private nonagricultural payrolls (dollars per hour) (*33*),

OLR = labor return per hour of operator and family farm labor (dollars per hour)

MHOL = man-hours of operator and family farm labor per operator per year,

U = average unemployment rate in the United States (percent) (*4*).

All coefficients have the theoretically correct sign and all are significantly different from zero at the 1-percent level. The Durbin-Watson statistic allows one to reject the hypothesis of autocorrelated error terms.

Equations were also fitted, using return per hour of operator and family farm labor rather than the spread between this variable and nonfarm sector wage rates. Equations fitted with OLR rather than (AHWR − OLR) resulted in lower R^2's, lower Durbin-Watson statistics, and coefficients on the variable OLR which were generally of the right sign, but were not statistically significant. This suggests that farm operators are more concerned with hourly earnings in agriculture *relative* to hourly earnings in the nonfarm sector, rather than with the mere *level* of their own hourly earnings in agriculture.

One can convert the per capita estimate derived from equation (2.1) to an aggregate estimate of nonfarm income of the farm population as shown in equation (2.2):

$$(2.2)\quad NNFI = PNNFI \cdot POP$$

Where:

NNFI = aggregate income of the farm population from nonfarm sources (million dollars)

POP = farm population (millions) (*30*).

Capital consumption

The third item under sources of funds in table 1 is capital consumption. This item is equivalent to depreciation of buildings plus depreciation of farm machinery and motor vehicles. These values can be estimated from equations (1.10) and (1.11) respectively.

Net changes in real estate debt

The net change in farm real estate debt can be defined as follows:

$$(4.1)\quad \Delta RED_t = RED_{t1} - RED_{to}$$

Where:

ΔRED_t = annual net change in farm real estate debt,
RED_{t1} = real estate debt outstanding at the end of the period,
RED_{to} = real estate debt outstanding at the start of the period.

But:

$$(4.2)\quad RED_{t1} = RED_{to} + RED_{NML_t} - RED_{RPY_t}$$

Where:

RED_{NML_t} = new money loaned on real estate during the period,
RED_{RPY_t} = loan repayments made during the period plus the amount of default loans written off.

Substituting (4.2) into (4.1) and canceling terms we get:

$$(4.3)\quad \Delta RED_t = RED_{NML_t} - RED_{RPY_t}$$

Given any two of the three items, ΔRED_t, RED_{NML_t}, or RED_{RPY_t}, the third can be solved for. Since the fourth source of funds listed in table 1 involves net changes in real estate debt, efforts here center on estimating ΔRED_t.

Conceptually one can classify loans secured by farm real estate according to the following purposes: (a) purchases or improvements of farm real estate assets, (b) purchases or improvements of nonreal estate assets, operating expenses, or other farm uses, and (c) nonfarm uses. All debt owed to production credit associations, regardless of whether it was secured by farm real estate, is excluded in references to "real estate debt" and "loan secured by farm real estate." The determinants of borrowing for the second and third purposes may differ substantially from the first. Existing data series do not allow one to adequately disaggregate loans secured by farm real estate by purpose.

The determinants of net changes in farm real estate debt can be grouped in two broad categories—those affecting the supply of funds available to farm borrowers, and those affecting the demand for funds by farm borrowers. Under this classification scheme explicit reference to several items is not made. For example, prepayments, loan extensions, and loan defaults all affect the level of loans outstanding. These items are implicitly included in reference to demand related variables since they are primarily determined by income. From published data one cannot generally distinguish which factor or factors are causing changes in the level of debt outstanding.

The theoretical determinants of net changes in farm real estate debt owed to any given lending institution are numerous and diverse. One can classify these determinants into factors which affect demand and those which affect supply. Table 3 lists 10 potential determinants on the demand side and four on the supply side. While the list is not complete, the major determinants of net changes in farm real estate debt are believed to be included.

In attempting to fit equations with the theoretical determinants listed in table 3, two basic limitations arise. First, the categories of determinants are not mutually exclusive. Thus, independent variables to be included in the equations may relate to one or more of the theoretical determinants listed. Second, lack of data prevents one from quantifying several of the determinants in any meaningful manner. Given the above limitations, the specific form of the equations and the estimation procedure used are given in table 4. A discussion of exogenous variables follows.

Table 3—Theoretical determinants of net changes in farm real estate debt owed to any given lender

A. Demand:

1. Cost of borrowing
2. Availability of internal funds
3. Current return on real estate investments or expected future returns
4. Liquidity preferences of borrowers
5. Cost of funds and services provided by alternative lenders
6. Value of farm real estate transfer
7. Volume of land transfers
8. Availability of substitutes to purchase as a method of acquiring land control (renting land)
9. Quantity of farm real estate loans demanded from alternative lenders
10. Need or desire to convert short-term debt into long-term debt

B. Supply:

1. Return from lending
2. Availability of loanable funds
3. Security offered by borrowers
4. Comparative return between farm and nonfarm lending alternatives

Table 4—Model structure for estimating net changes in farm real estate debt by lending institution

Equation	Variables	Estimation procedure
Demand equation—Federal land banks	$\Delta RED_{FLB} = f(i_{NML}, RDPP, CA, \Delta NRED, NFI + NNFI)$	OLS
Demand equation—commercial banks.	$\Delta RED_{CB(d)} = f(i_{CB}, RDPP, CA, \Delta NRED, NFI + NNFI)$	2SLS
Supply equation—commercial banks	$\Delta RED_{CB(s)} = f(i_{CB}, LOF, \dot{i}_{CB} - Aaa)$	
Market-clearing equation	$\Delta RED_{CB(d)} = \Delta RED_{CB(s)}$	
Demand equation—life insurance companies . .	$\Delta RED_{LIC(d)} = f(i_{LIC}, RDPP, CA, \Delta NRED, NFI + NNFI)$	2SLS
Supply equation—life insurance companies. . .	$\Delta RED_{LIC(s)} = f(i_{LIC}\ TI, \dot{i}_{LIC} - IB)$	
Market-clearing equation	$\Delta RED_{LIC(d)} = \Delta RED_{LIC(s)}$	
Demand equation—individuals and other	$\Delta RED_{IND(d)} = f(i_{IND}, RDPP, CA, \Delta NRED, NFI + NNFI)$	2SLS
Supply equation—individuals and other.	$\Delta RED_{IND(s)} = f(i_{IND}, \Delta I_{PPRE}, \dot{i}_{IND} - Y_{EQ})$	
Market-clearing equation	$\Delta RED_{IND(d)} = \Delta RED_{IND(s)}$	
Farmers Home Administration.	$\Delta RED_{FHA} = Z$	
Total net change in farm real estate debt	$\Delta RED_{TOT} = \Delta RED_{FLB} + \Delta RED_{CB} + \Delta RED_{LIC} + \Delta RED_{IND} + \Delta RED_{FHA}$	

Exogenous variables:

i_{NML} = interest rate on new loans by Federal land banks. Changes in quantity demanded (supplied) are a function of price. As price increases, one would expect the quantity demanded to decrease and the quantity supplied to increase. The true cost of borrowing (return from lending) includes the interest rate, service charges, and some factor to reflect losses (gains) from compensating balances and other forms of rationing. Data for these implicit costs (returns) are generally not available. Therefore, interest rates are used as a proxy for the true cost of borrowing (return from lending). Further, data on the interest rate on *new loans* for the entire period studied are available only for Federal land banks. For other institutions, available data reflect the *average* interest rate on all loans outstanding. One alternative is to use the average interest rate on all loans outstanding as a proxy for the interest rate on new loans. However, since real estate loans may be outstanding for extremely long periods, sporadic movements in rates on new loans would result in a much more moderate movement in average rates. A second alternative, and the one used here, is to use the rate on new loans by Federal land banks as a proxy for the rate on new loans by other institutions. This implicitly assumes that lending institutions are extremely sensitive to rates charged by competitors and will react accordingly. This assumption was not tested but appears reasonable in light of available evidence.

RDPP = ratio of debt to purchase price. The ratio of debt to purchase price measures the percentage of the purchase price of farmland which is financed by borrowed capital. As the ratio of debt to purchase price increases, one would expect farm real estate debt to increase also. An increasing ratio of debt to purchase price may reflect a lack of available internal funds and/or an increase in the value of farm real estate transfers.

CA = capital appreciation of farm real estate assets. Capital appreciation is defined here as the annual change in the nominal value of farm real estate assets, less capital improvements. The level of capital appreciation represents current or expected future returns to investment in real estate. Since capital appreciation also provides increases in equity which can be used as collateral for additional borrowing, it is hypothesized to be positively related to changes in farm real estate debt.

ΔNRED = net changes in farm nonreal estate debt. Borrowers are likely to favor short-term loans over long-term loans when there is a great deal of uncertainty concerning either the cost of capital or the price of assets they are considering for purchase. As uncertainty eases, borrowers may convert short-term loans to long-term loans. They may also make such conversions during periods of short-run financial difficulties, to ease the financial strain. For these reasons, it is hypothesized that net decreases in nonreal estate debt may result in net increases in farm real estate debt. Conversion of short-term debt to long term appears to be feasible (and desirable at times), but the reverse is seldom true. Thus net changes in nonreal estate debt may be treated as an exogeneous variable rather than as being determined endogenously with net changes in real estate debt.

NFI + NNFI = net farm plus nonfarm income. Net farm income is one measure of current returns to the factors of production and perhaps forms the main basis for expected future returns. However, net farm income also affects the availability of internal funds. As internal funds increase, one might expect net changes in real estate debt to decline, because the funds may be used to repay existing debt or to purchase assets on a cash basis. Alternatively, as internal funds increase, the ability to "finance" larger purchases using larger amounts of borrowed capital is clearly present. Thus the relationship between internal funds and net changes in real estate debt could be positive or negative. A problem arises in defining internal funds for the farm sector. Should one include nonfarm income of the farm sector? Can one use net farm income directly as a measure of internal funds? Since the purpose of this report is to determine the impact of changes in selected variables on sources of funds, whether an explanatory variable relates to one or more theoretical determinants is not of particular importance. No attempt is made to distinguish net farm from nonfarm income, since the business-household unit has both sources of income to draw from when considering investment in farm real estate.

LOF = loanable funds at country member banks. The ability of banks to lend depends upon the level of their deposits and the reverse requirements placed on these deposits. Loanable funds are defined here as one minus the reserve requirement on demand deposits, times the level of demand deposits, plus one minus the reserve requirements on time deposits, times the level of time and savings deposits. Since farm mortgage lending is a very small fraction of the total lending of all banks, it seems appropriate to restrict consideration to those banks which have significant amounts of farm mortgage loans. Thus consideration was limited to country banks which are members of the Federal Reserve System. Conceptually one would like to measure loanable funds at *all* country banks, including nonmember banks, but data are not available for this measurement.

$\bar{i}_{CB} - Aaa$ = spread in yields, commercial bank farm mortgage loans and Aaa bonds. As the spread between the average interest rate on commercial bank farm mortgage loans and the yield of Aaa bonds increases, one would expect the supply of farm mortgage funds offered by commercial banks to increase. While farm mortgage loans are likely to have a longer maturity, Aaa bonds are believed to be an alternative long-term investment for commercial banks.

TI = total annual investments made by life insurance companies. Life insurance companies tend to hold a diversified portfolio of investments. Farm mortgage loans compose a small fraction of the portfolio. Nonetheless, as total investments of life insurance companies increase, the supply of farm mortgage funds is also hypothesized to increase.

$\bar{i}_{LIC} - IB$ = spread in yields, life insurance company farm mortgage loans and industrial bonds. Industrial bonds and farm mortgage loans represent alternative long-term investment opportunities for life insurance companies. Therefore, it is hypothesized that as the spread in yields between the average interest rate on life insurance company farm mortgage loans and the yield on industrial bonds increases, the supply of life insurance company farm mortgage loans will increase.

ΔI_{PPRE} = net change in the index of prices paid on farm real estate. As prices paid (received) for the sale of real estate increase, the buyer must invest a greater sum of capital to purchase a given tract of land while the seller has a greater sum of capital to spend or find alternative investments for. Also, as the price of real estate assets increases, the seller may need to offer convenient financing arrangements to consummate the sale. Therefore, it is hypothesized that as the index of prices paid for farm real estate increases, the supply of funds offered by individuals will also increase.

$\bar{i}_{IND} - YEQ$ = spread in yields, individual farm mortgage loans and common stock. It is hypothesized that as the yield on farm mortgage loans increases relative to the rate of return on common stocks, the supply of farm mortgage funds from individuals will increase. However, since the seller can achieve the same total return with various combinations of interest rate and sale price, the spread in alternative yields (which does not take into account the sale price) is likely to be only a partial reflection of the true importance of differences in returns.

Endogenous variables:

ΔRED_{FLB} = demand for federal land bank loans measured as the annual net change in farm real estate debt owed to Federal land banks (FLB's). Since supply is assumed to be perfectly elastic, no supply equation is estimated.

ΔRED_{CB} = demand for and supply of commercial bank farm mortgage loans measured as the annual net change in farm real estate debt owed to commercial banks.

i_{CB} = proxy for the interest rate paid (received) on commercial bank farm mortgage loans measured as the interest rate on new loans by FLB's.

ΔRED_{LIC} = demand for and supply of life insurance company farm mortgage loans measured as the annual net change in farm real estate debt owed to life insurance companies.

i_{LIC} = proxy for the interest rate paid (received) on life insurance company farm mortgage loans measured initially as the interest rate on new loans by FLB's.

ΔRED_{IND} = demand for and supply of individual and other farm mortgage loans measured as the annual net change in farm real estate debt owed to individuals and others.

i_{IND} = proxy for the interest rate paid (received) on individual and other farm mortgage loans measured as the interest rate on new loans by FLB's.

ΔRED_{FHA} = Z, a predetermined variable which represents congressional appropriations for Farmers Home Administration direct lending on farm real estate.

ΔRED_{TOT} = an identity which states that the aggregate net change in farm real-estate debt is equal to the summation of the net change for the specific lending institutions.

The model of net changes in farm real estate debt was estimated by ordinary least squares (OLS) or two-stage least squares (2SLS) when appropriate. In equations estimated by 2SLS, both the supply and demand equations are normalized on the quantity variable rather than on the price variable. Results of the estimations are reported in table 5.

Equation (4.4) represents the demand for Federal land bank loans. A supply equation was not estimated since the supply curve was assumed to be perfectly elastic. Results of the estimation indicate that all regression coefficients have the expected sign. The regression coefficient for capital appreciation is not significantly different from zero at the usually acceptable levels. The coefficient for the rate of interest is significantly different from zero at the 10-percent level, while coefficients for the other three variables are significantly different from zero at the 1-percent level.

Equations (4.5D) and (4.5S) represent demand and supply, respectively, for net changes in farm real estate debt owed commercial banks. The two equations represent a simultaneous system and were estimated by two-stage least squares. Both equations are overidentified by the order condition and both satisfy the rank condition for identification. The regression coefficient for net change in nonreal estate debt is positive, whereas the hypothesized relationship was negative. The positive coefficient is perhaps explained by the fact that of all the institutions supplying farm real estate loans, only commercial banks also supply significant amounts of farm nonreal estate loans. Thus farm borrowers may seek to maintain, or are forced to maintain, a balance between commercial bank real estate and nonreal estate loans. All other variables, with the exception of CA, are significantly different from zero at the 10 percent level or less.

Equation (4.5S) is the supply function for commercial banks. The spread between yields on farm and nonfarm investments is measured by the difference between the average interest rate on commercial bank farm mortgages and the yield on Aaa bonds. The regression coefficient for this variable is significantly different from zero at the 1-percent level. Conceptually, the spread between returns on farm mortgage and short-term (less than 1 year) placements may also affect supply. However, preliminary analysis indicated that variables of this nature added virtually nothing to the explanatory power of the equation. For this reason, and to avoid problems of multicollinearity among variables, the spread between returns on farm mortgages and short-term placements was excluded from the supply equation for commercial banks. One of the primary determinants of a bank's ability to lend is the level of its deposits and the reverse

Table 5—Regression estimates of net changes in farm real estate debt for major lending institutions[1]

Equation No.	Equation	R^2
(4.4).	$\Delta RED_{FLB} = -2060.1 - 53.736\, i_{NML} + 28.253\, RDPP + 1.986\, CA - 82.569\, \Delta NRED + 39.86\, NFI + NNFI$	0.928
	(32.57)** (4.83)*** (4.62) (29.18)*** (8.10)***	
(4.5D). . . .	$\Delta RED_{CB} = -856.07 - 69.384\, i_{CB} + 17.151\, RDPP + 2.788\, CA + 26.83\, \Delta NRED + 9.64\, NFI + NNFI$	0.836
	(33.52)** (4.63)*** (3.98) (25.07) (7.19)*	
(4.5S). . . .	$\Delta RED_{CB} = -863.63 + 56.63\, i_{CB} + 0.00626\, LOF + 173.80\, (\hat{i}_{CB} - Aaa)$	0.866
	(52.34) (0.00099)*** (55.88)***	
(4.6D). . . .	$\Delta RED_{LIC} = -1526.2 - 282.31\, i_{LIC} + 41.04\, RDPP + 2.07\, CA - 50.868\, \Delta NRED + 27.665\, NFI + NNFI$	0.912
	(28.63)*** (3.97)*** (3.33) (21.37)*** (6.17)***	
(4.6S). . . .	$\Delta RED_{LIC} = -1966.7 + 315.38\, i_{LIC} + 6.9795\, TI + 520.85\, (\hat{i}_{LIC} - IB)$	0.812
	(88.59)*** (3.03)** (87.39)***	
(4.7D). . . .	$\Delta RED_{IND} = -2605.3 - 244.31\, i_{IND} + 51.946\, RDPP + 11.90\, CA - 41.895\, \Delta NRED + 42.816\, NFI + NNFI$	0.865
	(125.93)** (15.23)*** (9.27)** (52.36) (18.94)***	
(4.7S). . . .	$\Delta RED_{IND} = 308.87 + 101.98\, i_{IND} + 33.995\, \Delta I_{PPRE} + 27.266\, (\hat{i}_{IND} - Y_{EQ})$	0.729
	(70.81)*** (11.81)*** (43.27)	

[1] Because they are not valid in a strict statistical sense, R^2's for equations estimated by two-stage least squares are presented for the intuitive appeal they may possess and not for hypothesis testing.

requirements placed upon those deposits. The regression coefficient for the level of loanable funds was found to be significantly different from zero at the 1-percent level. The coefficient on the interest rate variable was not statistically significant at the 10-percent level or less.

Equations (4.6D) and (4.6S) are demand and supply equations for farm real estate debt held by life insurance companies. Both equations are overidentified by the order condition and both satisfy the rank condition for identification. For the demand equation, all regression coefficients have the theoretically correct signs, and all except the coefficient for capital appreciation are significantly different from zero at the 1-percent level. In the supply equation, all coefficients have the theoretically correct sign and all are significantly different from zero at the 5-percent level or less. The spread between returns on life insurance company farm mortgage loans and returns on short-term placements was not included for the reason cited in the discussion of the supply equation for commercial banks.

Estimates of the supply and demand equations for farm real estate debt held by individuals and others are reported in equations (4.7D) and (4.7S) respectively. The equations satisfy the rank and order conditions for identification. For the demand equation, all coefficients have the hypothesized sign and all but the one for ΔNRED are significantly different from zero at the 10-percent level or less. For the supply equation, all coefficients have the expected sign although the coefficient for $(i_{IND} - Y_{EQ})$ is not statistically significant.

No attempt was made to estimate net changes in farm real estate debt owed to the Farmers Home Administration, because the volume of direct lending by the Farmers Home Administration is influenced more by the volume of funds appropriated than by supply and demand conditions. Over time, however, congressional appropriations may respond to past demands. For simulation purposes, net changes in debt owed to the Farmers Home Administration are treated as exogenously determined.

Net changes in nonreal estate farm debt

Net changes in nonreal estate farm debt can be defined in a manner similar to that developed for real estate debt in equations (4.1) through (4.3). Corresponding to item 5 in table 1, efforts here center on estimating net changes in nonreal estate debt. All debt owed to production credit associations (PCA's) is classified here as nonreal estate debt.

Conceptually one can classify nonreal estate loans by purpose, using the same categories listed earlier for real estate debt: (a) purchases or improvements of farm real estate assets, (b) purchases or improvements of nonreal estate assets, operating expenses, or other farm uses, and (c) nonfarm uses. Again the data series do not allow one to adequately disaggregate nonreal estate loans by purpose. It is believed that the majority of nonreal estate loans are used for purpose (b). A study of PCA loans made in 1966 (*21*, table 10) indicated that only 7 percent of the total amount advanced was for the purpose of buying farm real estate or to improve land and buildings.

Determinants of net changes in nonreal estate debt can be classified into two categories—those affecting the supply of funds available to farm borrowers, and those affecting the demand for funds by farm borrowers. By examining current knowledge about the demand for nonreal estate funds and the groups supplying these funds to the farm sector, one can gain information about the supply and demand factors which influence net changes.

Available data series allow one to distinguish six different groups which provide nonreal estate funds to the farm sector. These groups are the Farmers Home Administration, Federal intermediate credit banks, PCA's, commercial banks, Commodity Credit Corporation (CCC), and nonreporting creditors.[14] Although CCC price-support loans are nonrecourse loans, they are treated as debts in the BSFS. However, since sums of money received for crops placed under CCC loans are considered income in the farm income accounts and were included in the income equations developed earlier, we exclude them from consideration here to avoid double accounting.

Nonreporting creditors are estimated to be the largest source of nonreal estate debt. The estimate of nonreal estate farm debt owed to nonreporting creditors is developed as follows: "From the most recent census survey for which data are available, an estimate is made of the nonreal estate farm debt outstanding from merchants, dealers, and other miscellaneous lenders as a percentage of the total outstanding nonreal estate loans of the lenders reporting annually. This proportion is applied to the nonreal estate debt of reporting lenders for intercensal years to provide an estimate of the debt of nonreporting lenders" (*34*, p. 18). Therefore, it would be inappropriate to estimate net changes in nonreal estate debt owed to nonreporting creditors and apply statistical tests of significance to the results derived.

The Farmers Home Administration holds roughly 4 percent of all nonreal estate debt outstanding, excluding CCC loans. As with farmownership loans, the supply curve of nonreal estate loans by the Farmers Home Administration may be considered nearly perfectly inelastic in the short run since it is primarily determined by

[14] Nonreporting creditors include merchants, dealers, agricultural credit corporations, livestock loan companies, small loan companies, and private individuals.

congressional appropriations. For this reason, no attempt is made here to estimate net changes in nonreal estate debt owed to the Farmers Home Administration.

Federal intermediate credit banks (FICB's) hold an extremely small fraction of the total nonreal estate debt outstanding. The primary functions of FICB's are to discount loans for and make loans to PCA's and to work with PCA's on loan standards and problem cases. Loans outstanding to FICB's have been only about 5 percent of the combined total of PCA's and FICB's. For these reasons, loans outstanding to PCA's and FICB's were treated as one, and the combined total is referred to as loans outstanding to PCA's. The percentage of all nonreal estate loans outstanding, excluding CCC loans, held by PCA's was slightly over 8 percent in 1949 and increased to over 16 percent by 1969. Commercial banks are the second largest source of nonreal estate debt, exceeded only by nonreporting creditors. Commercial banks held roughly 40 percent of all nonreal estate loans outstanding in both 1949 and 1969.

The supply of and demand for nonreal estate funds has received little empirical investigation. A study by Herr (*8*, p. 23) of aggregate net changes in nonreal estate debt did not include the interest rate as an explanatory variable. Herr assumed that supply was perfectly elastic and that factors associated with the supply of nonreal estate credit are minor and can be ignored. While this assumption appears valid for PCA's, it seems completely inappropriate for the Farmers Home Administration, which is included in Herr's aggregate net change figures. In addition, it is questionable whether the assumption is valid for commercial banks. There is also an implied assumption in Herr's model that the demand for nonreal estate debt is either very highly or perfectly inelastic. This hypothesis is not tested.

An earlier paper by Wehrly (*35*) reported a simultaneous model fitted to the level of institutional nonreal estate debt outstanding and the rate charged for that debt. The title of Wehrly's paper—"An Unsuccessful Exploration into the Structure of the Institutional Non-Real-Estate Farm Credit Market"—is an indication of the potential problems in an investigation of this nature. Wehrly states that "the analysis failed to identify any significant relationships between price and quantity of this type of credit." While Herr and Wehrly do not provide equations that can be used here to estimate net changes in nonreal estate debt, they do offer some very useful clues on the variables one may wish to include in regression estimates.

In estimating a functional equation, one is faced with the problem of defining the theoretical determinants of the function and selecting the data series which quantify the theoretical determinants. In practice, a data series generally quantifies, at least in part, more than one theoretical determinant.

For reasons cited earlier, it is probably appropriate to estimate only net changes in nonreal estate farm debt owed to commercial banks and PCA's. The specific form of the model tested here is presented in table 6.

Exogenous variables in table 6 are defined as follows:

ΔCE = net changes in cash expenditures. These changes reflect changes in annual cash outlays required for the production of agricultural products by the farm sector. As these cash outlays increase, one would expect the demand for nonreal estate debt to increase also. Herr included this variable in estimating aggregate net changes in nonreal estate farm debt and found it to be significant at the 1-percent level.

GFI/CE = ratio of gross farm income to cash expenditures. This ratio is one measure of the availability of internal funds. As the ratio increases, one would expect a decrease in the demand for nonreal estate debt. Herr included a variable very similar to this and found it to be significant at the 1-percent level.

WR = wage rate paid hired farm laborers. Wehrly suggested the inclusion of this variable to account for capital-labor substitution in agriculture. As the wage rate increases there is a greater incentive to replace labor with capital. Since the purchase of additional capital may require borrowed funds, one would expect a positive relationship between wage rates paid hired farm laborers and the demand for nonreal estate capital.

FICB = Federal intermediate credit bank debenture rate. FICB's are the primary source of loanable funds for PCA's. Therefore, as the rates paid by FICB's on the debentures they issue increase, one would expect the rates charged on PCA loans to increase as well.

4-6 MPCP = rate of interest on 4-to-6 month prime commercial paper. Commercial banks have numerous investment alternatives, both long and short term. The interest rate charged by commercial banks is hypothesized to be a positive function of the rate of 4-to-6-month prime commercial paper. As the rate of interest received on 4-to-6-month prime commercial paper increases, one would expect banks to increase the supply of funds committed to short-term commercial loans. Due to a reduction in supply, the interest rate on nonreal estate farm loans would be likely to increase until an equilibrium between farm and nonfarm rates was achieved.

ΔLOF = net change in loanable funds of country member banks. An increase in the supply of loanable funds represents a shift to the right in the supply curve of commercial bank loan funds. As supply increases, one would expect a negative effect on the rate of interest.

Endogenous variables in table 6 are as follows:

Table 6—Model structure for estimating net changes in farm real estate debt owed to commercial banks and production credit associations

Equation	Variables[1]	Estimation procedure
Demand equation—production credit associations. . .	$\Delta NRED_{PCA} = f[i_{PCA}, \Delta NRED_{CB}, \Delta CE, GFI/CE, WR]$	2SLS
Price equation—production credit associations.	$i_{PCA} = f[\Delta NRED_{PCA}, FICB]$	
Demand equation—commercial banks.	$\Delta NRED_{CB} = f[i_{CB}, \Delta NRED_{PCA}, \Delta CE, GFI/CE, WR]$	
Price equation—commercial banks.	$i_{CB} = f[\Delta NRED_{CB}, i_{PCA}, 4\text{-}6\ MPCP, \Delta LOF]$	

[1] See text for definitions of variables.

$\Delta NRED_{PCA}$ = demand for production credit association loans, measured as the annual net change in nonreal estate loans owed to production credit associations and Federal intermediate credit banks.

i_{PCA} = average interest rate (including service fees) paid by farmers on loans obtained from production credit associations.

$\Delta NRED_{CB}$ = demand for commercial bank nonreal estate farm loans, measured as the annual net change in nonreal estate loans owed to commercial banks.

i_{CB} = average interest rate (including service fees) paid by farmers on nonreal estate loans obtained from commercial banks.

The model for net changes in nonreal estate farm debt was estimated by two-stage least squares. Demand equations are normalized on the quantity variable while supply equations are normalized on the price variable. Results of the estimation are reported in table 7.

Equation (5.1D) is the demand equation for nonreal estate loans from production credit associations. The equation satisfies the rank condition and is overidentified by the order condition. Coefficients for all variables have the theoretically correct sign and all are significantly different from zero at the 10-percent level or less. The regression coefficient for $\Delta NRED_{CB}$ is negative, indicating that with other things equal, nonreal estate debt owed to PCA's declines as nonreal estate debt to commercial banks increases. This indicates that nonreal estate loans from commercial banks are considered substitutes for PCA loans. The results of this equation also suggest that the demand for PCA loans is strongly influenced by capital-labor substitution and the level of cash expenditures.

Equation (5.1S) is the price equation used to estimate the cost of PCA loans. The equation satisfies the rank condition and is overidentified by the order condition. The regression coefficient for $\Delta NRED_{PCA}$ is not significantly different from zero. Therefore, one cannot reject the hypothesis that the supply curve for PCA loans is perfectly elastic. The interest rate on FICB debentures was found to be significantly different from zero. However, a substantial portion of the variation in PCA interest rates remains unexplained. A comparison of the data series indicates that from 1949 to 1969 the spread in average interest rates charged by PCA's and the average rate paid on FICB debentures ranged from a high of 4.93 percentage points in 1949 to a low of 0.39 percentage point in 1969. Therefore, factors other than FICB debenture rates play some part in determining the interest rates charged by PCA's. Since PCA's operate as a borrower cooperative, one might expect the interest rate on PCA loans to decline as the level of retained earnings increases. Equations which included the level of retained earnings and the ratio of returned earnings to loans outstanding were also tested. These equations did not significantly increase the percentage of variation explained.

Equation (5.2D) represents the demand equation for nonreal estate farm loans from commercial banks. The

Table 7—Regression estimates of net changes in nonreal estate farm debt owed to selected institutional lenders

Equation No.	Equation	R^2
(5.1D). . . .	$NRED_{PCA} = 4022.9 - 156.71\, i_{PCA} - 0.8677\, \Delta NRED_{CB} + 251.47\, \Delta CE - 2223.5\, GFI/CE + 805.19\, WR$ $(104.65)^{*}\quad (0.5295)^{*}\quad (116.72)^{**}\quad (1326.9)^{**}\quad (215.83)^{***}$	0.931
(5.1S). . . .	$i_{PCA} = 5.7025 - 0.0002537\, \Delta NRED_{PCA} + 0.2729\, FICB$ $(0.0006732)\quad (0.0761)^{***}$	0.741
(5.2D). . . .	$NRED_{CB} = 4936.8 - 115.93\, i_{CB} - .121\, \Delta NRED_{PCA} + 234.89\, \Delta CE - 2668.4\, GFI/CE + 49.22\, WR$ $(384.24)\quad (1.119)\quad (79.53)^{***}\quad (1000.0)^{***}\quad (663.07)$	0.861
(5.2S). . . .	$i_{CB} = 6.056 + 0.0004743\, \Delta NRED_{CB} + 0.2009\, (4\text{-}6\ MPCP) - 0.0052\, \Delta LF$ $(0.00017384)\quad (0.0315)^{***}\quad (0.0156)$	0.778

equation is overidentified by the order condition and satisfies the rank condition for identification. All coefficients have the theoretically correct sign, but only the regression coefficients for ΔCE and GFI/CE are significantly different from zero. While the coefficient on the wage rate paid hired farmworkers was significantly different from zero in the equation for PCA's, for commercial banks the coefficient was much smaller and was not significantly different from zero at the 10-percent level.

Equation (5.2S) is the price equation for nonreal estate farm loans by commercial banks. The equation satisfies the identification criteria. All coefficients have the theoretically correct sign, but only the coefficient for 4-6 MPCP is significantly different from zero. This suggests that the interest rate paid by farmers for nonreal estate farm loans from commercial banks is influenced by interest rates paid by commercial lenders on short-term loans. As with PCA's, a rather substantial amount of variation in the interest rates charged by banks is unexplained.

Capital appreciation

Net capital appreciation on farm real estate is defined as the net change in the value of real estate, less expenditures for capital improvements.[15] It is hypothesized here that capital appreciation of farm real estate assets is a function of fluctuations in prices received and paid by farmers, the interest rate paid on new real estate loans, and the quantity of land in farms. As prices received by farmers increase relative to prices paid, one would expect capital appreciation to increase. Changes in prices received relative to prices paid will most likely alter expected future income, which will in turn alter the capitalized value of land. A large portion of farm real estate purchases are at least partially financed with borrowed funds. Therefore, one might expect a negative relationship between the price of land, and hence the level of capital appreciation, and the interest rate on new farm mortgage loans.

The impact of changes in the quantity of farmland on the value of farm real estate depends upon the own price elasticity of demand for farm real estate. If the demand for land is inelastic, decreases in the quantity of land in farms would increase the total value of remaining land in farms. The elasticity of demand for farm real estate is hard to determine a priori. One of the most important factors influencing the elasticity of demand for any commodity is the availability of substitutes. In the context of productivity, land has substitutes in the form of irrigation, fertilization, etc. However, in the context of space, land has few good substitutes. In a broader context, reductions in the quantity of land in farms measures the demand for land for nonfarm uses.

[15] The term "net capital appreciation" is used here because the net change in the market value of assets can also be defined as gross appreciation less depreciation plus capital improvements. For income tax purposes it is useful to distinguish depreciation from gross appreciation.

Results of the regression estimate using the aforementioned variables are presented in equation (6.1):

$$(6.1)\quad CA_t = 177.066 - \underset{(1.06)^{***}}{2.71}\, i_{NML} + \underset{(0.091)^{***}}{0.4619}\,(\Delta I_{PR} - \Delta I_{PP}) - \underset{(35.08)^{***}}{134.347}\, LIF$$

Period of fit: 1949-69

$R^2 = 0.772 \quad D\text{-}W = 2.59$

Where:

i_{NML} = interest rate on new money loaned by Federal land banks (percent) (*27*),

$\Delta I_{PR} - \Delta I_{PP}$ = net change in the index of prices received by farmers, minus net change in the index of prices paid by farmers (1957–59 = 100),

LIF = quantity of land in farms (billion acres) (*32*).

Regression coefficients for all variables are significantly different from zero at the 1-percent level and all have the theoretically correct sign. The Durbin-Watson statistic allows one to reject the hypothesis of autocorrelated error terms.

Regression Estimates of Uses of Funds

Capital expenditures on nonreal estate assets

Capital expenditures on nonreal estate assets are equal to the net change in the stock of farm machinery and equipment plus the level of depreciation of these items. Stated in equation form:

$$(7.1)\quad CENRA = TVM_t - TVM_{t-1} + DPNR_m$$

Where:

CENRA = capital expenditures on nonreal estate assets (million dollars),

TVM = total value of farm machinery and equipment (million dollars),

$DPNR_m$ = annual depreciation of farm machinery and equipment (million dollars).

Equation (1.8) provides an estimate of $DPNR_m$. Therefore, if one obtains an estimate of TVM, then one can estimate CENRA.

It is hypothesized that most of the variation in year-end stocks of farm machinery and motor vehicles can be explained by a simple version of the capital stock adjustment model. It is hypothesized that the desired stock of farm machinery and motor vehicles is a function of the level of net farm income per operator and the wage rate paid hired labor. As net income increases, the desired stock of farm machinery and equipment is also expected to increase. Likewise, as farm wage rates increase one might expect the desired stock of farm machinery to increase because of the desire to substitute capital for labor. The capital stock adjustment model, however, suggests that the desired level will not be obtained in one time period. Results of the capital stock adjustment model are presented in equation (7.2):

$$(7.2)\quad TVM_t = -1.6632 + \underset{(0.00044)^{**}}{0.00100\, NFI/FO} + \underset{(3.34)^{*}}{4.3541\, WR} + \underset{(0.088)^{***}}{0.6974\, TVM_{t-1}}$$

Period of fit: 1949–70

$R^2 = 0.993$ D-W = 2.06

Where:

TVM = total value of farm machinery and equipment (billion dollars) (*28*),

NFI/FO = the annual level of net farm income per farm operator (dollars) (*30*),

WR = farm sector wage rate (dollars) (*27*).

All regression coefficients have the expected sign and all are significantly different from zero at the 10-percent level or less. From equation (7.2) one can calculate the adjustment coefficient, i.e., the rate at which the gap between desired and actual stocks is closed. The adjustment coefficient is defined as one minus the regression coefficient on the lagged dependent variables. The adjustment coefficient of 0.3026 (1.0000 − 0.6974) indicates that only 30 percent of the gap between desired and actual stocks of farm machinery and motor vehicles is closed in one time period. Combining results of equation (7.2) and estimates of depreciation reported earlier in equation (1.8) allows one to estimate capital expenditures on nonreal estate assets as suggested in equation (7.1).

Net changes in inventories

The second use of funds listed in table 1 is net changes in farm inventories. Earlier, equation (1.6) provided a method for estimating crop and livestock inventories. Net changes in inventories are included in the calculation of net farm income on the sources-of-funds side of the account. Conventional treatment for a SAUF statement of this nature is to also include net changes in inventories as a use of funds. Therefore, further estimation of this item is not required.

Net changes in financial assets

Equations with which to estimate year-end stocks of demand deposits and time and savings deposits have been developed by Penson (*18, 19*). Penson's estimates of year-end stocks of financial assets are part of an overall system of simultaneous equations which he used to determine the portfolio balance between physical and financial assets and liabilities held by farm proprietors. While Penson's estimates are part of a simultaneous system, one can also obtain reasonable estimates of year-end stocks using ordinary least squares estimates. OLS estimates of demand deposits and time and savings deposits per farm household unit are reported in equations (9.1) and (9.2) respectively:

$$(9.1)\quad SDDBH = 0.01266 - \underset{(0.0036)^{***}}{0.01539\, R_{DD}} + \underset{(0.0006)^{***}}{0.0015\, R_{TD}} - \underset{(0.00024)^{***}}{0.00095\, R_{MB}} - \underset{(0.000110)^{***}}{0.0003348\, R_{EQ}} + \underset{(0.000264)^{*}}{0.000375\, SPABH} + \underset{(0.1495)^{**}}{0.2647\, LSDDBH}$$

Period of fit: 1948-69

$R^2 = 0.81$ D-W = 2.55

$$(9.2)\quad STDBH = 0.00366 - \underset{(0.00336)^{***}}{0.01016\, R_{DD}} - \underset{(0.0006)^{***}}{0.00215\, R_{TD}} - \underset{(0.00021)^{***}}{0.000848\, R_{MB}} - \underset{(0.0124)^{**}}{0.02714\, YBH} + \underset{(0.00379)^{***}}{0.00888\, SPABH} + \underset{(0.1489)^{***}}{0.6242\, LSTDBH}$$

Period of fit: 1948-69

$R^2 = 0.996$ D-W = 1.96

Where:

SDDBH = stock of demand deposits per farm business household deflated by the GNP price deflator,

STDBH = stock of time and savings deposits per farm business household unit deflated by the GNP price deflator,

R_{DD} = service charge on demand deposits,

R_{TD} = rate of return on time and savings deposits,
R_{MB} = rate of return on marketable Government bonds,
R_{EQ} = rate of return on common stocks (Moody's),
SPABH = stock of physical assets per farm business household unit deflated by the GNP price deflator,
LSDDBH = lagged value of SDDBH,
LSTDBH = lagged value of STDBH,
YBH = level of gross farm income plus nonfarm income per farm business household unit deflated by the GNP price deflator.

All coefficients in equations (9.1) and (9.2) have the hypothesized sign and all are significantly different from zero at the 10-percent level or less. The adjustment coefficients indicate that gaps between desired and actual stocks are closed almost twice as fast for demand deposits as for time and savings deposits. A more complete explanation of these equations is given by Penson.

Equations (9.1) and (9.2) are in terms of real stocks per farm business household. Equations (9.3) and (9.4) are the equations used to convert to aggregate nominal stocks, while equations (9.5) and (9.6) are those needed to determine net changes in nominal stocks:

(9.3) $SDD = SDDBH \cdot GNP \cdot NFO$

(9.4) $STD = STDBH \cdot GNP \cdot NFO$

(9.5) $\Delta SDD = SDD_t - SDD_{t-1}$

(9.6) $\Delta STD = STD_t - STD_{t-1}$

Where:

SDD = nominal stock of demand deposits held by the farm sector (million dollars),
GNP = GNP price deflator (*14*),
NFO = number of farm operators (million) (*27*),
STD = nominal stock of time and savings deposits held by farm sector (million dollars).

Total investment in real estate assets

The annual total investment in farm real estate assets is defined here as the net change in the market value of farm real estate assets. Using the estimated levels for the stock of farm real estate assets, one can estimate total annual investment in farm real estate assets. In equational form:

(10.1) $TIRA = TVRE_t - TVRE_{t-1}$

The total value of farm real estate assets can be estimated indirectly as:

(10.2) $TVRE_t = CA_t + CI_t + TVRE_{t-1}$

Where:

$TVRE_t$ = estimated total value of farm real estate assets at end of period,
CA_t = estimated level of net capital appreciation during the period,
CI_t = estimated level of capital improvements during the period.

Equation (6.1) provides an estimate of net capital appreciation. By obtaining an estimate for capital improvements, one can use equation (10.2) to estimate the stock of real estate assets.

Farm capital improvements can be classified as expenditures on "farm operator dwellings" and "other buildings and land improvements." Expenditures on farm operator dwellings should vary with the number of farm operators, while improvements in general should increase as income increases. Equation (10.3) reports the function used to estimate farm capital improvements:[16]

(10.3) $CI = 110.05 + \underset{(0.00614)^{***}}{0.01837}\ NFI + \underset{(32.72)^{*}}{45.65}\ NFO + \underset{(0.206)^{***}}{0.598}\ CI_{t-1}$

Period of fit: 1949-69
$R^2 = 0.90$ D-W = 2.02

Where:

CI = annual level of capital improvements to farm real estate (million dollars) (*30*),
NFI = net farm income (million dollars) (*30*),
NFO = number of farm operators (million) (*27*).

Regression coefficients for all variables have the theoretically correct sign and all are significantly different from zero at the 10-percent level. The Durbin-Watson statistic allows one to reject the hypothesis of autocorrelation at the 1-percent level.

Indirect estimates of the stock of real estate assets were obtained by adding the estimated levels of capital

[16] Equations which included short-term and long-term interest rates with the above variables were also estimated. In both cases the regression coefficient was not significantly different from zero and did not have the theoretically correct sign.

Table 8—Estimated total value of farm real estate assets at end of year, United States, 1950-69

Year	CA_t from equation (6.1)	CI_t from equation (10.3)	Equational estimated stock of farm real estate assets	Reported stocks of farm real estate assets[1]	Deviation: reported minus estimated
	Bil. dol.	*Bil. dol.*	*Bil. dol.*	*Bil. dol.*	*Bil. dol.*
1949....	-1.5	1.6	76.7	75.3	-1.4
1950....	5.2	1.5	83.5	86.6	3.1
1951....	8.6	1.6	93.7	95.1	1.4
1952....	0.0	1.6	95.3	96.5	1.2
1953....	-1.4	1.5	95.4	95.0	-0.4
1954....	2.9	1.5	99.8	98.2	-1.6
1955....	3.5	1.4	104.7	102.9	-1.8
1956....	4.4	1.4	110.5	110.4	-0.8
1957....	3.4	1.3	115.2	115.9	0.7
1958....	6.8	1.4	123.4	124.4	1.0
1959....	0.9	1.3	125.6	130.2	4.6
1960....	3.7	1.3	130.6	131.7	1.1
1961....	5.2	1.3	137.1	138.0	0.9
1962....	7.0	1.3	145.4	143.8	-1.6
1963....	6.7	1.3	153.4	152.1	-1.3
1964....	7.5	1.2	162.7	160.9	-1.2
1965....	9.1	1.3	172.5	172.5	0.0
1966....	9.4	1.3	183.2	182.5	-0.7
1967....	10.5	1.3	195.0	193.1	-1.9
1968....	7.2	1.3	203.5	202.6	-0.9
1969....	4.3	1.3	209.1	208.2	-0.9

[1] Source: Balance Sheet of the Farming Sector (*28*).

appreciation and capital improvements to the level of real estate stocks at the beginning of the period. Results of these calculations are reported in table 8. The deviations are small when compared with BSFS estimates. The sum of the deviations is $0.2 billion, indicating that on average the equationally estimated total value of farm real estate is roughly equivalent to the BSFS estimate. The average absolute deviation, however, is slightly over $1.0 billion per year. This represents less than a 1-percent deviation on average.

Ancillary Regression Estimates

To estimate a balance sheet using the simulation model under construction, it is necessary to estimate (or take as given) the stock of all physical and financial assets of the farm sector. As indicated in equation (10.2), real estate assets of the farm sector can be estimated by adding the estimated levels of net capital appreciation and capital improvements to the stock of real estate assets at the start of the estimation period. Likewise, one can estimate the stock of crops and livestock at the end of the period by adding the estimated net change in crop and livestock inventories to inventories at the start of the estimation period. Equation (12.1) illustrates an equation of this nature:[17]

$$(12.1)\quad CROLIV_t = CROLIV_{t-1} + \Delta I$$

Where:

$CROLIV_t$ = crop and livestock inventories on farms (million dollars),

ΔI = annual net change in crop and livestock inventories (million dollars).

Equation (7.2) provides an estimate of year-end stocks of machinery and motor vehicles. Equations (9.3) and (9.4) provide estimates of year-end stocks of demand deposits and time and savings deposits respectively. The only remaining asset of the farm sector reported in the BSFS which has not been estimated is the stock of household furnishings and equipment. The number of households in the farm sector declined rapidly from 1949 to 1969. Therefore it seems appropriate to estimate the level of household furnishings and equipment on a per

[17] The stock of inventories is from BSFS data, while ΔI is taken from equation (1.6) which is based on FIS data. Historically net changes in inventories reported in FIS and summed over a number of years are lower than net changes in stocks based on BSFS data (see footnote 6). Thus estimates of crop and livestock inventories obtained in the manner depicted in equation (12.1) will have a tendency to be lower than BSFS estimates.

household basis rather than in aggregate terms. It was decided to test a simple version of the capital stock adjustment model to estimate the level of household furnishings and equipment per farm household. Results are reported in equation (12.2):

$$(12.2)\quad HFEQH_t = .135 + \underset{(0.00004)^{**}}{0.00008}\, NFIH_t + \underset{(0.10)^{***}}{0.85}\, HFEQH_{t-1}$$

Period of fit: 1949-69
$R^2 = 0.954$ D-W = 2.06

Where:

$HFEQH_t$ = value of household furnishings and equipment per farm household (dollars) (*28*),
NFIH = annual level of net farm income per farm household (dollars) (*30*).

Both regression coefficients have the expected sign and both are significantly different from zero at the 5-percent level. The D-W statistic allows one to reject the hypothesis of autocorrelated error terms. The speed-of-adjustment coefficient indicates that a gap between actual and desired levels of household furnishings and equipment is closed quite slowly.

THE SIMULATION MODEL

Structure of the Model

The general form of the simulation model constructed here is given in figure 1. The user must first specify the initializing parameters which control the point in time at which the simulation is to begin and the number of periods to be simulated. The program then reads in data cards which contain the values for all exogenous variables to be used in the equations contained in the model. Then the farm income and nonfarm income equations are solved and if necessary converted to aggregate nominal values. The farm income statement is then printed. Next, net changes in real estate and nonreal estate debt are determined by simultaneous equations. Equations used to estimate stock values for the balance sheet are calculated and printed. Next, values for the SAUF statement are determined and printed. If the desired number of time periods has been simulated the program is ended, and if not, all necessary parameters are updated and the next time period is run.

The model can best be characterized as a recursive system which contains within it several small systems of simultaneous equations. Table 9 outlines the equations used in the model and the order in which these equations are used in the model. The statistical properties of these equations were given earlier in this report.

Table 9 classifies equations by their "recursive order." Recursive order as used here can best be explained by example. Suppose we have three equations of the following form:

$$(1)\quad Y_1 = f(X_1, X_2, Y_{3_{t-1}})$$

$$(2)\quad Y_2 = f(Y_1, X_3)$$

$$(3)\quad Y_3 = f(Y_2, X_4)$$

The first equation is of recursive order 1, because it can be solved for one time period in a recursive system without any other equation being solved. This does not imply that Y_1 is completely independent of the remainder of the system, since the value for Y_1 in the second period of the simulation run would be affected by the estimated value of Y_3 in the previous period. If the term $Y_{3_{t-1}}$ were not included in the first equation it would still be of order 1. Equation (2) is of order 2 since it requires the solution of one (or more) equations of order 1 before it can be solved. Equation (3) is of order 3 because it requires the solution of one (or more) equations of order 2 before it can be solved. The order of solution in the simulation model for equations of the same recursive order is not important.

As indicated in table 9, the equations used in forming gross and net farm income identities are of order 1. Only two other equations are of order 1. Thus the simulation program essentially operates from a position with net farm income determined before most other sources of funds are determined. Equations used to estimate net changes in real estate debt are of the highest recursive order and are therefore strongly influenced by the estimates from lower recursive order equations.

The simulation model is written in FORTRAN language. Two subroutines used to calculate the simultaneous equations for net changes in real estate and nonreal estate debt are called by the main program. A complete listing of the simulation model is provided in (*11*).

Time paths of exogenous variables

To run the simulation model for future periods, it is necessary to specify the time paths of exogenous variables included in equations underlying the model. There are, of course, a large number of exogenous variables in a model of this size. The following discussion describes

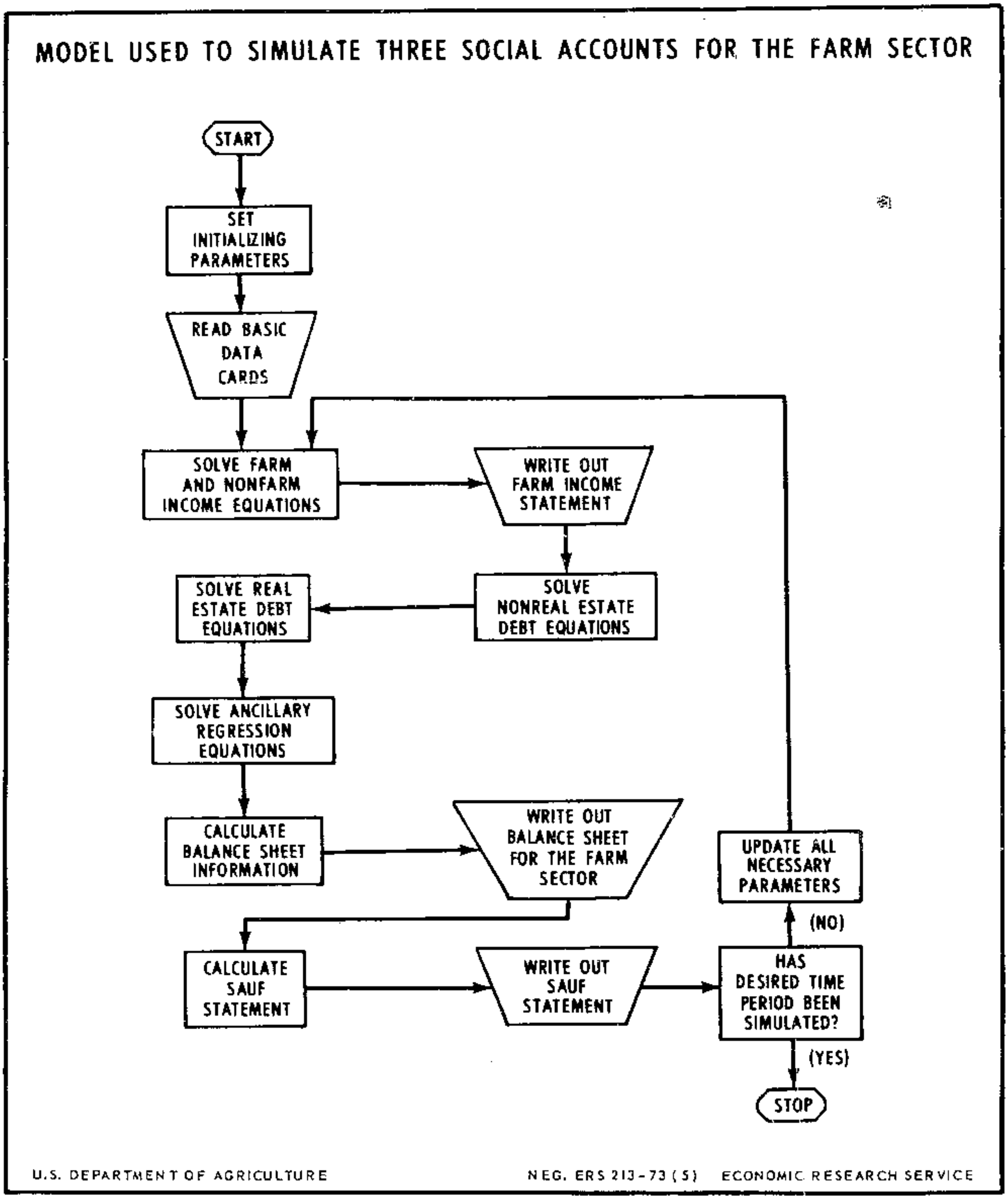
MODEL USED TO SIMULATE THREE SOCIAL ACCOUNTS FOR THE FARM SECTOR
START
SET INITIALIZING PARAMETERS
READ BASIC DATA CARDS
SOLVE FARM AND NONFARM INCOME EQUATIONS
WRITE OUT FARM INCOME STATEMENT
SOLVE NONREAL ESTATE DEBT EQUATIONS
SOLVE REAL ESTATE DEBT EQUATIONS
SOLVE ANCILLARY REGRESSION EQUATIONS
CALCULATE BALANCE SHEET INFORMATION
WRITE OUT BALANCE SHEET FOR THE FARM SECTOR
CALCULATE SAUF STATEMENT
WRITE OUT SAUF STATEMENT
HAS DESIRED TIME PERIOD BEEN SIMULATED?
(NO)
UPDATE ALL NECESSARY PARAMETERS
(YES)
STOP
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 213-73 (5)
ECONOMIC RESEARCH SERVICE

Figure 1

Table 9—Equational ordering for the simulation model of farm sector social accounts

Equation used in simulation	Description	Order of solution in simulation model[1]	Recursive order
1.4	Cash receipts from marketings plus value of home consumption	1	1
1.5	Gross rental value of farm dwellings	2	1
1.6	Net changes in farm inventories	3	1
1.7	Interest on farm mortgage debt	4	1
1.8	Current operating expenses plus net rent to nonfarm landlords	5	1
1.9A	Log of taxes levied on farm property	6	1
1.9B	Taxes levied on farm property	7	1
1.10	Depreciation of farm buildings	8	1
1.11	Depreciation of farm machinery and equipment	9	1
1.12	Accidental damage	10	1
1.2	Gross farm income identity	11	2
1.3	Gross farm expenses identity	12	2
1.1	Net farm income identity	13	2
2.1	Per capita nonfarm income of the farm population	14	3
2.2	Aggregate nonfarm income of the farm population	15	3
10.3	Capital improvements	16	3
6.1	Capital appreciation of real estate assets	17	1
10.2	Total value of farm real estate assets	18	4
7.2	Total value of farm machinery and motor vehicles	19	1
5.1D	Demand for nonreal estate farm loans from production credit associations	20s	4
5.1S	Interest rate paid on production credit association loans	20s	4
5.2D	Demand for nonreal estate farm loans from commercial banks	20s	4
5.2S	Interest rate paid on nonreal estate farm loans from commercial banks	20s	4
4.4	Demand for farm real estate loans from Federal land banks	21	5
4.5D	Demand for farm real estate loans from commercial banks	22s	5
4.5S	Supply of farm real estate loans from commercial banks	22s	5
4.6D	Demand for farm real estate loans from life insurance companies	23s	5
4.6S	Supply of farm real estate loans from life insurance companies	23s	5
4.7D	Demand for farm real estate loans from individuals and other	24s	5
4.7S	Supply of farm real estate loans from individuals and other	24s	5
12.2	Household furnishings and equipment per farm household	25	3
9.1	Real stock of demand deposits per farm business household	26	4
9.3	Aggregate nominal stock of demand deposits	27	4
9.5	Net change in nominal stock of demand deposits	28	4
9.2	Real stock of time and savings deposits per farm business household	29	4
9.4	Aggregate nominal stock of time and savings deposits	30	4
9.6	Net change in nominal stock of time and savings deposits	31	4
12.1	Stock of crop and livestock inventories on farms	32	2
7.1	Capital expenditures on nonreal estate assets	33	2
10.1	Total annual investment in real estate assets	34	5

[1] An s after a number indicates the equation is part of a simultaneous system.

how the time paths for the exogenous variables were chosen. Some of the choices may be arbitrary. Some were chosen by use of a linear or curvilinear trend equation. Note that any of the following assumptions can easily be changed and incorporated into the simulation model.

Government payments: Government payments to farmers increased substantially during the 1960's. In 1970 the majority of payments were under the feed grain, wheat, and cotton programs. The Agricultural Act of 1970, which controls these programs, expires on December 31, 1973. It is therefore assumed that Government payments in 1971-73 will equal the level of payments in 1971. It is further assumed that Government payments from 1974 through 1980 will be reduced to 75 percent of their 1971 level.

Index of farm production and output (I_{OUT}): The index of farm production and output has shown a consistent upward trend over time. Equation (8.1) is a semilog trend equation for this variable:[18]

[18] Items in parentheses below regression coefficients are standard errors with *** indicating significance at the 1-percent level. Time is measured as 1900 = 0, 1901 = 1, . . . , 1970 = 70, etc. The numbering scheme for equations in this section does not relate to the numbering scheme in table 1.

$$(8.1)\quad \text{LOG } I_{OUT} = 1.5674 + \underset{(0.00023)^{***}}{0.0075095}\ \text{TIME}$$

Period of fit: 1949-69
$R^2 = 0.983$ D-W = 2.25

This equation is used to project the index of farm production and output to 1980. The increasing rate of growth in output is consistent with the assumed cutback in Government support programs.

Index of the volume of marketing and home consumption (I_{VMHC}): One would expect a very close relationship between I_{OUT} and I_{VMHC}. A semilog trend for I_{VMHC} is reported in equation (8.2):

$$(8.2)\quad \text{LOG } I_{VMHC} = 1.4385 + \underset{(0.00027)^{***}}{0.0084209}\ \text{TIME}$$

Period of fit: 1949-69
$R^2 = 0.980$ D-W = 1.96

As expected, the results of (8.1) and (8.2) indicate that the volume of output and marketings will increase in roughly the same proportion over time.

Index of prices received: Writing in 1970, Culver and Chai (*4*, p. 66) state: "Although prices received by farmers for all farm products are not expected to rise in the next few years, they may show a slight upward trend by 1980. Nevertheless, the increase may be somewhat less than the projected increase in general price levels." More recent evidence, however, indicates that prices received have risen substantially in the last 2 years. It is assumed here that the index of prices received by farmers will increase by 2 percent each year.

Implicit GNP price deflator: Culver and Chai (*4*, p. 62) state: "General price increases are assumed to slow gradually in the next few years to around 2 percent per year, then remain at about 2 percent per year for the rest of the decade." Again, more recent evidence suggests a higher rate of price increases. Therefore it is assumed here that the implicit GNP price deflator will increase 3 percent per year to 1980.

Index of prices paid: The index of prices paid by farmers has increased steadily over time. A continued rise is expected. The rise in the index is assumed to match the increase in the implicit GNP price deflator.

Land in farms: Land in farms increased from 1949 to 1953, but has declined since then. It is assumed here that land in farms will decline by 5 million acres per year. This implies a decline of land in farms from 1.118 billion acres in 1969 to 1.063 billion in 1980, a decline of about 5.5 percent. This rate of decline is roughly comparable to that experienced in 1949–69.

Average hourly wage rate of nonsupervisory employees on nonagricultural payrolls: Wage rates in the nonfarm sector have increased rapidly over time. This trend is assumed to continue. Over time, real income has also increased. Therefore, it is assumed here that wage rates will increase 3 percent per year to match the growth in the implicit GNP price deflator, plus an additional 2 percent per year to reflect growth in real income. This implies a 5 percent growth in wages per year, compared with a growth rate of roughly 4 percent since 1949.

Wage rates paid hired farm laborers: Projected increasing wage rates in the nonfarm sector are consistent with an assumed increasing wage rate in the farm sector. The wage rate paid hired farm laborers as a percentage of the wage rate in the nonfarm sector has increased in recent years, and this trend is expected to continue. Therefore wage rates paid hired farm laborers are assumed to increase from 43 percent of nonfarm wage rates in 1971 to 52 percent in 1980. This gives a projected farm wage rate of \$2.76 per hour in 1980. A later section explores agricultural wage rates in more detail.

Interest rates: Nine different interest rates or rates of return are treated as exogenous in the simulation model. These include the interest rates on (1) time deposits, (2) new money loaned by Federal land banks, (3) Aaa bonds, (4) industrial bonds, (5) 4-to-6-month prime commercial paper, (6) demand deposits, (7) marketable bonds, (8) equities, and (9) FICB debentures. Clearly these rates are interrelated, some more than others. No attempt was made here to fit a term structure for interest rates. There has been a rather strong linear trend on all of the rates indicated. However, most short-run projections of interest rates indicate a leveling off or slight decline in the near future. Therefore, it is assumed here that all interest rates will be at their 1967–70 average level for the projections made to 1980.

Total hours of labor used in agriculture: A straight linear trend on total hours of labor used in agriculture would imply a zero labor requirement in agriculture by 1981. Clearly this is unreasonable. Therefore, it is assumed here that total hours of labor used will decline by 4 percent each year from the previous year's total. This implies a curvilinear trend downward in total labor used in farming, but a trend that will never go to zero. The 4 percent annual decline from the previous year's total is slightly lower than the rate of decline experienced during the 1960's. Projected in this manner, total hours of labor used in farming would decline from 6,527 million hours in 1970 to 4,338 million hours in 1980.

Total hours of hired labor: Hired labor as a percentage of total labor used in farming increased during the 1950's. However, during the 1960's, hired labor constituted roughly 33 percent of the total labor used in agriculture.

This relationship is used here to project hired labor usage to 1980. Under this assumption, hired labor usage declines to an estimated 1,445 million hours in 1980.

Number of farms: The number of farms in the United States has decreased substantially since 1935. Further declines are expected. During the 1950's and early 1960's, farm numbers declined each year by over 3 percent of the previous year's total. During the late 1960's, the annual rate of decline slowed to 3 percent or under, according to estimates. It is assumed here that the annual rate of decline in farm numbers from the previous year's total will be 3 percent in 1972 and 2.2 percent by 1980. This procedure implies 2.27 million farms in 1980. Unlike a linear trend, the number of farms estimated in this manner will never reach zero.

Farm population: Farm population declined from over 24 million in 1949 to just over 10 million in 1969. This decline resulted not only from a substantial decline in the number of farm households, but also from a decline in the number of persons per household. From 1959 to 1969, farm population per farm household declined from about 3.95 to 3.47. It is assumed here that this trend will continue so that farm population per farm household will decline to 3.04 by 1980. The estimated number of farms multiplied by the estimated farm population per farm household gives an estimated farm population of 6.90 million in 1980.

Employment rate in the U.S. economy: The unemployment rate in the U.S. economy did not show a significant trend either upward or downward during 1949-69. It is assumed here that unemployment will average 4.5 percent per year to 1980.

Ratio of debt to purchase price (RDPP): The ratio of debt to purchase price for farm real estate loans increased from roughly 55 percent in the early 1950's to 74 percent in March 1969. Because of tight financial conditions, the ratio dropped to 73 percent in 1970 and 65 percent in 1971. A renewed increase is expected, however, due to recent legislation allowing a high ratio of loan to normal agricultural value by Federal land banks and because of the expected continued increase in farm size. It is assumed that the ratio of debt to purchase price will increase 4 percentage points in 1972, 3 percentage points in 1973, 3 percentage points in 1974, and 1 percentage point each year thereafter.

Total investment of life insurance companies (TI): During 1949-69, the total investments made by life insurance companies increased at an increasing rate. Therefore, it is assumed that investments of life insurance companies projected to 1980 will follow a semilog trend, as shown in equation (8.3):

$$(8.3) \quad \text{LOG TI} = 2.463 + \underset{(0.00207)^{***}}{0.032197}\ \text{TIME}$$

Period of fit: 1949-69
$R^2 = 0.880$ D-W = 1.14

Net change in CCC loans: The net change in CCC loans outstanding has not shown any significant trends in recent years. But since output is projected to expand, it is assumed that CCC loans will increase $0.1 billion per year.

Net changes in nonreal estate debt to nonreporting creditors: Warren, Evans, and Eitel (*34*, p. 18) state: "Recent estimates are that the debt held by nonreporting lenders is equivalent to 70 percent of the nonreal estate debt held by reporting lenders." Therefore, net changes in nonreal estate debt to nonreporting creditors are projected at 70 percent of net changes in nonreal estate debt to commercial banks and PCA's. Since the latter two are endogenously determined, the former are also endogenously determined in projections to 1980.

Net changes in real estate and nonreal estate debt owed to Farmers Home Administration: The emphasis on Farmers Home Administration loans appears to be shifting from loans for the purchase of farm real estate and nonreal estate assets to items such as rural housing and community development which encourage rural nonfarm development. With the projected decline in farm numbers, this trend is expected to continue. Therefore, net changes in real estate loans are projected to decrease $20 million per year while net changes in nonreal estate debt are projected at no change.

Total "other" financial assets: In recent years, "other" financial assets of the farm sector have been roughly equal to the level of deposits and currency. This relationship is assumed to continue in the future. Currency is estimated as 46 percent of demand deposits since this is the procedure used in deriving the BSFS estimate.

Loanable funds at country banks: Loanable funds at country banks increased rapidly during 1949-69. It is assumed here that loanable funds at country banks will increase 4.0 percent per year to 1980.

Value of crops stored off farms: The value of crops stored off farms represents crops which serve as collateral on nonrecourse CCC loans. Since the annual net change in the stock of CCC debt outstanding was assumed to increase $0.1 billion per year, the value of crops stored off farms is assumed to increase $0.1 billion per year also.

Net change in the index of prices paid on real estate (ΔI_{PPRE}): Net changes in the index of prices paid on real estate are highly correlated with the level of capital appreciation (CA) of real estate assets. Equation (8.4) expresses the linear relationship between the two.[19]

[19] This equation should not be viewed as a functional relationship. Rather, it merely measures the degree of the linear relationship between the two variables.

Since capital appreciation is determined within the model, equation (8.4) is incorporated into the simulation model so that for projection purposes, net changes in the index of prices paid on real estate are determined by this equation:

$$(8.4) \quad \Delta I_{PPRE} = 1.385 + \underset{(0.0648)^{***}}{0.8723\,CA}$$

Period of fit: 1949-69

$R^2 = 0.905$ D-W = 1.17

Other factors besides capital appreciation affect the change in the index of prices paid on real estate. However, the relationship appears strong enough that equation (8.4) can be used for projection purposes.

Imputed return to equity in nonreal estate assets: Imputed return to equity in nonreal estate assets is determined in the following manner: The level of nonreal estate debt is subtracted from the crops, livestock, and machinery inventories. This figure is multiplied by the weighted average (equal weights) rates on farm mortgages, equities, and marketable bonds.

Average interest rates on farm real estate loans outstanding by institution: Average interest rates can be estimated as follows: The average interest rates for loans made or recorded during the year and for loans carried over from earlier years are weighted by the amounts of such loans to give a weighted average interest rate of all loans outstanding. The simulation model, however, does not give estimates of loans made or recorded (which includes new money loaned plus refinanced loans). Therefore, the procedure used here is to estimate the volume of loans made or recorded based on historical relationships between this item and the stock of debt outstanding at the start of the year.

The ratio of farm mortgage loans made or recorded to the level of debt outstanding varies by lending institution. The average of this ratio during 1949-69 was 0.266, 0.193, 0.400, and 0.218 for Federal land banks, life insurance companies, commercial banks, and individuals and other, respectively. There was a noticeable downward trend in the ratio for all institutions from 1965 through 1969. This is explained by the fact that interest rates on new loans were substantially above the average interest rate. This factor would probably be associated with some slowdown in both new money loaned and the refinancing of existing mortgages. However, since interest rates are projected to level off at current rates, there would be a decreasing incentive to hold off on refinancing. A resultant rise in the ratio is therefore expected.

Based upon the aforementioned factors, the following assumptions were made about the ratio of mortgages made or recorded to debt outstanding: For Federal land banks, the ratio is projected to increase at the rate of 1 percentage point until 1973, at which time it will stabilize at 0.25. For life insurance companies, the ratio is projected to increase from 0.12 to 0.18 in increments of 0.01, after which it will remain constant. For commercial banks, the ratio is expected to move from 0.30 to 0.40 in increments of 0.02 and remain at that level. For individuals, the ratio is expected to increase from 0.20 to 0.22 in increments of 0.005 and remain at 0.22 to 1980. Based upon these assumptions, and the endogenous determination of the interest rate on new loans, one can estimate the average interest rate by lending institutions as outlined earlier.

Validation of the Model

Validation of a model in the strictest sense means to prove that a model is true. Naylor and Finger (*17*, p. B-93) point out that "to prove that a model is 'true' implies (1) that we have established a set of criteria for differentiating between those models which are 'true' and those which are 'not true', and (2) that we have the ability to apply these criteria to any model." In view of the problems in proving a model to be true or not true, validation of models has come to rely heavily on the theory of probability.

Naylor (*16*, p. 266) outlines two general approaches to model verification—verification by forecasting, and historical verification. Verification by forecasting has the obvious disadvantage of requiring either (1) great lengths of time before validation can be checked, or (2) the use of only a part of the sample information available when constructing the model. Historical verification is questionable in that to validate the model one typically uses the same data from which the model was developed.

A wide variety of tests have been developed for determining whether or not the relationships between simulated and actual time paths can be attributed to chance. Naylor and Finger have outlined eight of these "goodness of fit" tests. These techniques include Theil's inequality coefficient, spectral analysis, factor analysis, Kolmogorov-Smirnov test, regression analysis, and others. Howrey and Kelejian (*9*, pp. 211-212), however, challenge these methods of validating nonstochastic simulation models. After comparing the properties of actual and simulated results, they state that:

> . . . once the classical regression tests concerning the parameters and the residuals of an econometric model have been carried out, the results of further tests of the model via comparisons of linear functions of historical and simulated values of the

endogenous variables over the period of estimation contain *no additional information* concerning the validity of the model. This means that even if each equation is estimated by a single-equation technique, the results of simulation experiments yield no information concerning the validity of the model as an interrelated system. Moreover, if observations outside the period of estimation are available, tests of the model using such information should be conducted in terms of the known multivariate distribution theory concerning forecasting and *not* in terms of ad hoc comparisons between historical and simulated values of the endogenous variables.

Constants and nonestimated quantities assumed in the simulator are of course not covered by this general conclusion.

The preceding discussion indicates the diversity of opinion with respect to the topic of validation of computer models. Despite the comments of Howrey and Kelejian, it does seem appropriate to somehow check the internal consistency of the model and to obtain a better feel for how the simulator performs.

As a method of testing the internal consistency of the simulation model, the model was run for 1959-69. Variables generated within the model for time period $t - 1$ were used in generating the estimates in time period t. A detailed comparison of simulated and actual farm income statements, balance sheet statements, and SAUF statements is presented in the appendix.

As a method of assessing the overall relationship between simulated and reported values, the weighted average absolute percentage errors are reported in table 10. The weighted average absolute percentage error is defined here as the summation of the absolute values of the deviations between reported and simulated values divided by the summation of the absolute reported values.

A weighted average seems more appropriate than an unweighted average because of the nature of some of the variables, especially variables measured as a net change. As an example, suppose the reported and simulated values for net changes in farm inventories are as follows:

Year	Reported	Simulated	Deviation	Percentage deviation
1960	500	480	20	4
1961	−1	5	−6	−600

The unweighted average absolute percentage deviation is 302 percent, or (4 + 600)/2. However, this figure is misleading in that the absolute magnitude of the deviation was less in 1961 than in 1960. The weighted average percentage deviation as defined above gives a deviation of 5.2 percent (26/501). When there is little difference between percentage deviations, the weighted and unweighted averages would be roughly the same. There is also some tendency for the absolute average percentage error to be approximately equal to one minus the R^2 for the equation underlying the estimate.

As shown in table 10, the simulated level of net farm income had an average absolute error of 2.0 percent for the 11-year period simulated. The highest average error in the simulated farm income statement was for net changes in inventories. The appendix gives an explanation for this error. Because net changes in inventories are a small component of gross farm income, an error of this magnitude has little impact on the average absolute error of estimated gross farm income. For the applications to be discussed later, the simulation model is sufficiently accurate in estimating components of the farm income statement.

Average absolute percentage errors for components of the balance sheet statement are very low. Real estate assets, the major asset of the farm sector, were estimated for an 11-year period with only an average error of 0.9 percent. Total asset and liability estimates were off by an average of only 1.7 percent. The largest average absolute error was 12.7 percent for household furnishings and equipment. Simulation estimates of the stock of financial assets and levels of real estate and nonreal estate debt resulted in approximately a 1-percent error. On balance, it appears that the simulation model generates accurate estimates of the farm sector balance sheet.

Table 10 also gives the average absolute percentage errors for components of a SAUF statement. Total sources and uses of funds had an average absolute error of 5.5 percent for the 11-year period simulated. The simulation estimates of aggregate net changes in both real estate and nonreal estate debt are more accurate than the results for any of the specific lending institutions. Reasons for this phenomenon are given in the appendix. Net changes in demand deposits and currency and in time and savings deposits have relatively high average absolute percentage errors. This results from the fact that historically net changes in these assets have been very minor, and the equations used in deriving these estimates were intended primarily to estimate the stock of assets rather than the net change.

While the components of the SAUF statement may appear to have a rather high average absolute percentage error, net flow figures are being estimated. In converting these net flow figures to stock values, the percentage error on stock values is much less, as evidenced by results reported for the balance sheet. The results do indicate, however, that the accuracy of disaggregated fund flows is likely to be less than the accuracy of aggregated figures.

Table 10—Average absolute percentage errors in simulating from 1959 through 1969

Item	Average absolute percentage error
Farm income statement	
Gross farm income	0.8
Cash receipts from marketings plus value of products consumed directly	0.7
Gross rental value of farm dwellings	1.6
Net change in inventories	50.4
Government payments[1]	---
Gross farm expenditures	0.8
Cash operating expenses plus net rent to nonfarm landlords	1.6
Interest on farm mortgage debt	1.5
Taxes	2.6
Depreciation of farm buildings	8.9
Depreciation of farm machinery	3.8
Accidental damage	11.5
Net farm income	2.0
Balance sheet statement	
Physical assets:	
Real estate	0.9
Nonreal estate	4.9
Crops and livestock	5.7
Machinery and motor vehicles	2.6
Household furnishings and equipment	12.7
Financial assets	0.4
Demand deposits and currency	1.1
Time and savings deposits	1.4
Other reported[1]	---
Total	1.7
Liabilities:	
Real estate debt	0.9
Nonreal estate debt	1.7
Proprietors' equities	1.9
Total	1.7
Sources-and-uses-of-funds statement	
Sources:	
Net farm income	2.0
Nonfarm income of farm population	11.9
Capital consumption	3.8
Net change in farm real estate debt	9.4
Federal land banks	20.1
Commercial banks	[illegible]1.2
Life insurance companies	18.0
Individuals and other	17.7
Farmers Home Administration[1]	---
Net change in nonreal estate farm debt	15.5
Production credit associations	20.9
Commercial banks	32.4
Nonreporting creditors[1]	---
Farmers Home Administration[1]	---
Capital appreciation of real estate	23.9
Total	5.5

See footnote at end of table.

Table 10—Average absolute percentage errors in simulating from 1959 through 1969—Continued

Item	Average absolute percentage error
Uses:	
Capital expenditures on nonreal estate assets	22.3
Net change in crop and livestock inventories	50.4
Net change in financial assets	23.8
Demand deposits and currency	51.7
Time and savings deposits	22.5
Other reported[1]	...
Total investment in real estate assets	19.9
Proprietor withdrawals	4.9
Total	5.5

[1] Actual values, taken as given, not simulated.

SIMULATION RESULTS

The preceding sections outlined a model that can simulate three social accounts for the farm sector. This section reports results from using the simulation model (1) to make projections to 1980, and (2) to determine the impact of selected changes in exogenous variables in the system on financial structure of the farm sector.

Projections of Future Financial Structure

Economists have long recognized the value of projections in planning. Several studies have been specifically directed toward projecting some aspects of the future financial structure of the farm sector. Melichar and Doll (*13*, p. 13) summarized three projections of the level of selected farm capital stocks in 1980. These results are reported in table 11. The first set of estimates, model HT, was derived by Melichar based primarily on projections for 1960–79 published by Heady and Tweeten (*7*) in 1963. The second set of projections, model B, was published by Brake (2) in 1966, with real estate estimates updated in 1968. The third set of projections, model HM, is based upon projections made by Heady and Mayer (*6*) in 1967. More recently, Melichar (*12*) has estimated the level of capital stocks in 1980. Table 11 indicates the divergence in estimates, most of which can be attributed to differences in methodological approach and assumptions concerning time paths of exogenously determined variables.

There appears to be a great deal of variation in the quantitative and theoretical considerations underlying these projections. None of the projections explicitly provide either a farm income statement or a SAUF statement in conjunction with the balance sheet components. However, projection results developed herein are reported in terms of a balance sheet, a farm income statement, and a SAUF statement for 1980. This procedure allows one to examine the relationship among capital stocks and flows, although flows are measured largely as net flows rather than gross flows. Because of the differences in theoretical conceptualization and in assumptions concerning future values of exogenous variables, no attempt is made here to explain in detail the reasons for the differences in projection estimates.

Projection results and their implications

The simulation model was used to project capital stocks and net flows to 1980. The simulation run was started in 1969, the last year of data upon which the equations in the simulation model were developed. While the simulation model generated a farm income statement, balance sheet, and sources-and-uses-of-funds statement for each year, only the values for 1980 are discussed here.

Table 12 compares the actual farm income statement for 1970 and the projected farm income statement for 1980. Gross farm income is projected to be over $83.7 billion in 1980, an increase of about $26.9 billion over 1970. This represents an increase of 47.4 percent. Net farm income is projected to increase from a reported level of $15.9 billion in 1970 to roughly $17.2 billion in 1980, an increase of 8.1 percent. The projected increase in gross farm income, coupled with the projected decline in number of farms, indicates that average gross income per farm will increase from $19,500 in 1970 to $36,872 in 1980.

Both gross and net farm income are strongly influenced by assumptions concerning the volume of production and marketings as well as the levels of prices received and paid. A later section describes in more detail the sensitivity of projection results to the assumptions concerning trends in exogenous variables.

Table 11—Alternative projections of selected farm assets in 1980[1]

Item	Model			
	HT	B	HM	M
	Billion dollars			
Vehicles, machinery, and equipment	40.5	36.4	64.2	55.3
Livestock and crops	31.4	34.6	31.9	36.2
Deposits, currency, and savings bonds	25.2	15.7	25.2	18.1
Real estate	392.9	272.2	288.4	299.6
Total	490.1	358.9	409.7	409.2
	Percent of total			
Vehicles, machinery, and equipment	9	10	16	14
Livestock and crops	6	9	7	9
Deposits, currency, and savings bonds	5	4	6	4
Real estate	80	76	70	73
Total	100	100	100	100

[1] Adapted from: Melichar and Doll (*11*), "Capital and Credit Requirements of Agriculture and Proposals to Increase Availability of Bank Credit," table 3, p. 22.

Table 13 presents a balance sheet for the farm sector on January 1, 1970, and a projected balance sheet as of January 1, 1980. Real estate assets are projected to total over $315 billion by 1980. This compares with projected values ranging from $393 billion to $272 billion as reported in table 11, and an actual value of $208 billion in 1970. Nonreal estate assets are projected to increase from $78.1 billion in 1970 to $110.1 billion in 1980. Real estate assets were 67.2 percent of total assets in 1970 and are projected to account for 69.3 percent by 1980. Thus real estate is projected to account for an increasing proportion of the assets used in agriculture.

The value of crops and livestock is projected to increase to $42.2 billion by 1980. The value of machinery and motor vehicles is projected to increase to $57.0 billion by 1980. Projections of financial assets are not directly comparable with projections made in earlier studies because the financial assets included in the present study are more comprehensive.

The projected levels of real estate and nonreal estate debt are functionally related to projected income flows and asset levels. Real estate debt is projected to increase

Table 12—Farm income statements, 1970 and projected 1980

Item	Year		Change
	1970[1]	1980[2]	
	Million dollars		*Percent*
Gross farm income	56,806	83,730	47.4
Cash receipts from marketings plus value of products consumed directly	50,005	76,543	53.1
Gross rental value of farm dwellings	2,858	4,401	54.0
Net change in inventories	226	386	70.8
Government payments	3,717	2,400	−35.4
Gross farm expenditures	40,867	66,502	62.7
Cash operating expenses plus net rent to nonfarm landlords	29,238	45,457	55.5
Interest on farm mortgage debt	1,717	3,450	100.9
Taxes	2,994	7,398	147.0
Depreciation of farm buildings	1,824	2,128	16.7
Depreciation of farm machinery	4,855	7,759	59.8
Accidental damage	239	307	28.5
Net farm income	15,939	17,229	8.1

[1] Source: Farm Income Situation, July 1971 (*30*).
[2] Projected.

from $28.4 billion in 1970 to over $48.5 billion in 1980, an increase of over 70 percent in 10 years. Nonreal estate debt is projected to increase from $29.7 billion in 1970 to over $71.0 billion in 1980. The implications of this projection are revealing. From 1960 to 1970, nonreal estate debt was generally about equal to real estate debt. Yet is it projected that by 1980 nonreal estate debt will exceed real estate debt by $20.0 billion. What explains this change in the projected magnitude of nonreal estate debt? The explanation lies in the rather substantial increase in farm production expenses and machinery purchases, which is not matched by increases in either net farm income or financial assets. Thus, large increases in short-term borrowing will be needed to meet current production expenses and purchases of nonreal estate capital items.

Proprietors' equities are projected to increase from $251.5 billion in 1970 to over $334 billion in 1980, an average annual increase of over $8 billion. Despite these substantial increases in equity, the percentage equity in all assets is projected to decline from 81.2 percent in 1970 to 73.5 percent in 1980.

Table 14 presents a projected SAUF statement for the farm sector for 1980. Several of the items in table 14 have been discussed earlier. Projected nonfarm income of the farm population in 1980 is about 19 percent

Table 13—Balance sheets of the farming sector, United States, January 1, 1970, and projected 1980

Item	Year		Change
	1970[1]	1980[2]	
	Billion dollars		*Percent*
Physical assets:			
Real estate	208.2	315.4	51.5
Nonreal estate	78.1	110.1	41.0
Crops and livestock	34.4	42.2	22.7
Machinery and motor vehicles	34.1	57.0	67.2
Household equipment and furnishings	9.6	10.9	13.5
Financial assets	23.3	29.4	26.2
Demand deposits and currency	6.4	7.6	18.8
Time and savings deposits	5.5	7.1	29.1
Other reported	11.4	14.7	28.9
Total	309.6	454.9	47.0
Liabilities:			
Real estate debt	28.4	48.5	70.8
Nonreal estate debt	29.7	71.9	142.0
Proprietors equities	251.5	334.5	33.0
Total	309.6	454.9	46.9
	Percent of total assets		
Real estate assets	67.2	69.3	-----
Nonreal estate assets	25.3	24.2	-----
Crops and livestock	11.1	9.3	-----
Machinery and motor vehicles	11.1	12.5	-----
Household equipment and furnishings	3.1	2.4	-----
Financial assets:			
Demand deposits and currency	2.1	1.7	-----
Time and savings deposits	1.8	1.6	-----
Other reported	3.6	3.2	-----
	Percent of total liabilities		
Real estate debt	9.2	10.7	-----
Nonreal estate debt	9.6	15.8	-----
Proprietors' equities	81.2	73.5	-----

[1] Source: Balance Sheet of the Farming Sector, December 1971 (*29*).
[2] Projected.

Table 14—Projected sources and uses of funds for the farm sector, 1980

Item	Value	
	Million dollars	
Sources:		
Net farm income		17,229
Nonfarm income		14,519
Capital consumption		9,887
Net change in farm real estate debt		2,957
Federal land banks	608	
Commercial banks	647	
Life insurance companies	725	
Individuals and other	997	
Farmers Home Administration	−20	
Net change in farm nonreal estate debt		5,836
Production credit association (+ FICB)	1,945	
Commercial banks	1,487	
Nonreporting creditors	2,403	
Farmers Home Administration	0	
Capital appreciation of farm real estate		13,407
Total		63,836
Uses:		
Capital expenditures on nonreal estate assets		10,737
Net change in crop and livestock inventories		386
Net change in financial assets		786
Demand deposits and currency	177	
Time and savings deposits	216	
Other reported	393	
Total investment in real estate assets		15,169
Proprietor withdrawals (calculated residually)		36,758
Total		63,836

higher than the level reported for 1970. Per capita nonfarm income of the farm population, however, is projected to increase from $1,350 in 1970 to over $2,104 in 1980, an increase of roughly 56 percent.

Relationships between aggregate real estate and nonreal estate debt have already been discussed. Table 14 allows one to analyze projections of debt by lending institution. As indicated in table 14, individuals and other are projected to remain the dominant source of real estate loans. However, life insurance companies are projected to take a renewed interest in farm mortgage loans and are expected to provide substantial net increases in 1980. Commercial banks are projected to increase farm mortgage loans also. Although not presented in table 14, one can also project the level of debt outstanding by lending institution. The projected January 1, 1980, levels of real estate debt outstanding by lending institution are: Federal land banks $11.2 billion, commercial banks $8.4 billion, life insurance companies $9.3 billion, Farmers Home Administration $0.3 billion, individuals and other $19.3 billion, for a total of $48.5 billion (table 13).

During 1949-69, the annual net increase in nonreal estate debt owed to commercial banks was larger in absolute amounts than the increase in debt owed to production credit associations. However, PCA's have been gaining a larger share of the total market. By 1980, net increases in nonreal estate debt owed to PCA's are projected to be about 30 percent higher than for commercial banks. Total nonreal estate debt outstanding on January 1, 1980, is projected to be: commercial banks $22.4 billion, PCA's $16.3 billion, Farmers Home Administration $0.8 billion, nonreporting creditors $28.6 billion, and Commodity Credit Corporation $2.8 billion, for a total of $71.9 billion (table 13).

Capital appreciation is projected to be $13.4 billion in 1980. Total funds from all sources are projected to be $63.8 billion in 1980 compared with an estimated $40.8 billion in 1970. Proprietor withdrawals are expected to increase from about $29.9 billion in 1970 to $36.8 billion in 1980.

It is useful to examine the rates of return to labor and capital used in the farming sector implied by the 1980 projected values. Table 15 compares actual rates of return for 1970 and the projected rates of return for 1980. Equity in farm real estate assets is used as the residual claimant.

Imputed labor return projected for 1980 is somewhat higher than the 1970 level (table 15). While the wage rate used to impute labor returns rose sharply, the total hours of labor used in farming declined sharply. Imputed return to equity in nonreal estate assets is projected to decline. This is primarily the result of nonreal estate debt expanding much more rapidly than the value of nonreal estate assets.

Total imputed return to real estate assets is projected to increase slightly over 1970 levels. However, the percentage return on real estate assets is projected to decline from 3.98 percent in 1970 to 2.75 percent in 1980.[20] In evaluating the percent return on real estate assets one should keep in mind that capital appreciation is not included in the calculations. This explains, at least in part, why the percentage return on real estate assets is much less than the interest rate on farm mortgage loans.

[20] An estimate of the percentage return on real estate assets given in (*26*) for 1970 is 3.2 percent. The discrepancy between that estimate and the one derived here is traceable to the assumptions underlying the derivation of the estimates.

Selected modifications of exogenous variables

The preceding section outlined simulation results for a specific set of assumptions concerning time paths of exogenous variables. It is useful to explore alternative assumptions to determine the sensitivity of projection results to the underlying assumptions. Therefore, the following sections briefly review projection results when key assumptions are altered.

Modification A: More favorable parity price ratio. Base projection results were developed under the assumption that the index of prices paid by farmers would increase by 3 percent per year while the index of prices received by farmers would increase 2 percent per year. This implies a declining parity ratio over time. It is useful to explore the situation in which there is a more favorable relationship between prices received and prices paid. For modification A, it is assumed that the index of prices received and the index of prices paid will both increase

Table 15—Returns to assets and labor used in the farm sector, 1970 and projected 1980

Item	1970	1980
Net farm income:		
1. Net farm income (million dollars)	15,939	17,229
Imputed return to labor:		
2. Total hours of operator and family labor (million)	4,366	2,893
3. Wage rate paid hired farm laborers (dollars/hour)	1.42	2.76
4. Imputed return to labor (million dollars)[1]	6,200	7,984
Imputed return to equity in nonreal estate assets:		
5. Nonreal estate assets (million dollars)	78,100	110,130
6. Nonreal estate debt (million dollars)[2]	29,700	71,900
7. Equity in nonreal estate assets (million dollars)[3]	48,400	38,230
8. Return on nonreal estate assets (percent)[4]	5.33	4.95
9. Imputed return to equity in nonreal estate assets (million dollars)[5]	2,580	1,892
Residual return to equity in real estate assets:		
10. Farm real estate assets (million dollars)	208,200	315,380
11. Farm real estate debt (million dollars)	28,400	48,470
12. Equity in farm real estate assets (million dollars)[6]	179,800	266,910
13. Residual return to farm real estate assets (million dollars)[7]	7,159	7,353
Percent return to equity in real estate assets:		
14. Percent return to equity in real estate assets (percent)[8]	3.98	2.75

[1] Line 2 multiplied by line 3.
[2] Includes stock of nonrecourse loans outstanding to the Commodity Credit Corporation.
[3] Line 5 minus line 6.
[4] Weighted average interest rate (equal weights) on farm mortgages, equities, and marketable bonds.
[5] Line 7 multiplied by line 8.
[6] Line 10 minus line 11.
[7] Line 1 minus line 4 and line 9.
[8] Line 13 divided by line 12.

Table 16—Alternative projected farm income statements to 1980

Item	Base projection	Modification A	Modification B
	Million dollars		
Gross farm income	83,730	83,730	77,861
Cash receipts from marketings plus the value of products consumed directly	76,543	76,543	70,906
Gross rental value of farm dwellings	4,401	4,401	4,401
Net change in inventories	386	386	154
Government payments	2,400	2,400	2,400
Gross farm expenditures	66,502	63,256	60,562
Cash operating expenses plus net rent to nonfarm landlords	45,457	41,224	39,386
Interest on farm mortgage debt	3,450	3,544	3,501
Taxes	7,398	7,897	7,473
Depreciation of farm buildings	2,128	2,128	2,095
Depreciation of farm machinery	7,759	8,147	7,799
Accidental damage	307	316	154
Net farm income	17,229	20,473	17,299

by a compounded 2 percent per year. This implies a constant parity ratio over time. All other assumptions are identical to those used in the base projection. Projection results for modification A are given in tables 16 through 18.

Under modification A, projected net farm income in 1980 was $20.5 billion, 18.8 percent higher than the base projection. All categories of physical assets were higher under modification A than under the base projections. Financial assets declined. Real estate debt was somewhat higher, while nonreal estate debt dropped by over $2 million. Proprietors' equities were $10.1 billion higher. Nonfarm income under modification A was much lower than under the base projection. This indicates that farm and nonfarm sources of income are, at least to some degree, substitute sources of income for farm operators. Total funds from all sources were roughly 4.3 percent higher for modification A compared with the base projection. In summary, changes in the parity ratio are likely to affect almost all capital stock and flow items.

Modification B: Lower levels of inflation. Base projections were developed with the GNP price deflator and the index of prices paid by farmers increasing 3 percent per year, while the index of prices received by farmers was assumed to be increasing 2 percent per year. It is useful to examine the situation in which inflation is assumed to be lower. For modification B it is assumed that the index of prices paid by farmers and the GNP price deflator will increase at the rate of 1.5 percent compounded annually. The index of prices received by farmers is assumed to grow at the rate of 1 percent compounded annually.[21] This modification implies a rate of inflation one-half as fast as that assumed in the base projection.

Under modification B, gross farm income is projected to be $77.9 billion in 1980, $5.8 billion lower than the base projection. Net farm income is just slightly higher than the base projection. Thus from an income standpoint, farm operators are not likely to derive any substantial benefits from a lower level of inflation in both prices received and prices paid.

As a result of the assumed lower level of inflation, total assets of the farm sector projected for 1980 are virtually unaffected. However, the distribution of these assets among categories is affected. Real estate assets are estimated to be $3.8 billion higher under modification B than under the base projection. Nonreal estate assets are projected to be $2.3 billion lower. This results from the fact that crop and livestock inventories are valued lower because of the assumed lower prices. Financial assets are

[21] Since the price received for farm production is affected by the level of income, population, production, and other variables, some adjustment of other exogenous variables is needed to reflect a drop in prices received. Following the work of Penson (*18*) it is assumed here that the elasticity of demand for farm products with respect to income is 0.25 and that the elasticity of demand with respect to other prices is 0.05. It is further assumed that income and prices of other products grow at the same rate as the GNP price deflator. Thus, roughly 30 percent of the decline in the growth of the index of prices received from 2 percent to 1 percent is accounted for by a slower growth in income and prices of other products. The remaining portion of the decline is accounted for by an assumed higher level of marketings, which results in lower prices. Adjustments to quantities marketed were made under the assumption that the price elasticity of demand is -0.30.

Table 17—Alternative projected balance sheet statements to 1980

Item	Base projection	Modification A	Modification B
	Billion dollars		
Physical assets:			
Real estate	315.4	321.4	319.2
Nonreal estate	110.1	113.8	107.8
Crops and livestock	42.2	42.2	39.5
Machinery and motor vehicles	57.0	59.9	57.3
Household equipment and furnishings	10.9	11.6	11.0
Financial assets:			
Demand deposits and currency	7.6	7.3	7.1
Time and savings deposits	7.1	7.0	6.8
Other reported	14.7	14.3	14.0
Total	454.9	463.8	454.9
Liabilities:			
Real estate debt	48.5	49.4	49.0
Nonreal estate debt	71.9	69.8	68.9
Proprietors' equities	334.5	344.6	337.0
Total	454.9	463.8	454.9

Table 18—Alternative projected sources-and-uses-of-funds statements to 1980

Item	Base projection	Modification A	Modification B
	Million dollars		
Sources:			
Net farm income	17,229	20,473	17,299
Nonfarm income	14,519	12,810	14,620
Capital consumption	9,887	10,275	9,893
Net change in farm real estate debt	2,957	3,160	3,056
Federal land banks	608	702	662
Commercial banks	647	652	640
Life insurance companies	725	781	755
Individuals and other	997	1,045	1,017
Farmers Home Administration	–20	–20	–20
Net change in farm nonreal estate debt	5,836	5,462	5,271
Production credit associations	1,945	1,934	1,896
Commercial banks	1,487	1,279	1,204
Nonreporting creditors	2,403	2,249	2,171
Farmers Home Administration	0	0	0
Capital appreciation of farm real estate	13,407	14,331	13,869
Total	63,836	66,512	64,010
Uses:			
Capital expenditures on nonreal estate assets	10,737	11,627	10,717
Net change in crop and livestock inventories	386	386	154
Net change in financial assets	786	726	720
Demand deposits and currency	177	143	132
Time and savings deposits	216	220	229
Other reported	393	363	360
Total investment in real estate assets	15,169	16,093	15,527
Proprietor withdrawals	36,758	37,679	36,891
Total	63,836	66,512	64,010

projected to be $1.5 billion lower under modification B than for the base projection.

Real estate debt increased slightly as a result of the lower level of inflation. Nonreal estate debt, however, dropped by an estimated $3.0 billion. Proprietor equities rose by an estimated $2.5 billion. Thus, in terms of net worth, farm operators are likely to benefit from lower levels of inflation in both prices received and paid. As shown in table 17, sources and uses of funds change only slightly as a result of modification B.

Appraisal of Selected Public Policies and Programs

Alterations in reserve requirements for commercial banks

From 1959 through 1969, the reserve requirements placed upon country bank demand deposits ranged from a low of 11 percent to a high of 13 percent. Over the same period, the reserve requirements on time and savings deposits ranged from a low of 4 percent to a high of 6 percent. The Federal Reserve Board controls reserve requirements within legal maximum and minimum limits set by Congress.

Recently, the President's Commission on Financial Structure and Regulation (*22*, p. 1) was asked to "review and study the structure, operation, and regulation of the private financial institutions in the United States, for the purpose of formulating recommendations that would improve the functioning of the private financial system." Proposals for eliminating reserve requirements over time were included in the recommendations of the committee. To test what impact lower reserve requirements would have on farm loans by commercial banks, it was decided to simulate the 1959-69 period using the legal minimum reserve requirements.

The assumed easing of reserve requirements resulted in an increase in both real estate and nonreal estate debt owed to commercial banks (table 19). However, the increases are not great. Net changes in real estate debt are estimated to be $136 million greater over an 11-year period under the legal minimum reserve requirements than under the actual reserve requirements. This represents roughly a 2-percent increase. Nonreal estate debt was affected even less. Nonreal estate debt was estimated to be only $8 million higher under legal minimum reserve requirements than under the actual reserve requirements. Thus, lowering of reserve requirements is not expected to substantially alter the observed net changes in real estate and nonreal estate farm debt.

The above results probably reflect only a partial adjustment to changes in reserve requirements. The lowering of reserve requirements would probably lead to a greater volume of money in circulation. This is turn could lead to a higher level of inflation. As a result, both prices received and prices paid by farmers could be altered. If one knew the degree to which alterations in reserve requirements affected prices received and paid by farmers, then a more comprehensive analysis could be undertaken with the model as currently structured.

Minimum wage laws for all hired farm laborers

Proposals for minimum wage laws to be applied to all hired farm laborers have generated much public debate. For this reason, it was decided to simulate a situation in which a minimum wage law for hired farm laborers was assumed. The purpose is to determine the impacts such legislation might have on financial structure in the farm sector. However, this simulation also implies changes in underemployment in agriculture and earnings of hired laborers.

Tyrchniewicz and Schuh (*25*) developed a simultaneous system of equations with which to estimate supply and demand equations for hired farm labor, unpaid family labor, and operator labor. They estimated the short- and long-run price elasticities of demand for hired farm labor to be −0.26 and −0.49 respectively. For simulation purposes, an elasticity of demand for hired farm labor of −0.30 is assumed here. Tyrchniewicz and Schuh also estimated the substitution elasticity of hired labor for operator and family labor. They found that a 1-percent increase in hired farm labor would reduce operator labor by 0.2 percent. Thus an elasticity of substitution of hired labor for operator labor of −0.20 is used here.

It is assumed here that a law was in effect from 1959 through 1969 to require a minimum wage rate for all hired farm laborers of $1 per hour in 1959, with raises to $1.15, $1.25, $1.40, and $1.60 per hour in 1961, 1963, 1967, and 1968 respectively. These rates reflect the actual minimum wage rates for nonagricultural workers. Table 20 presents the estimated impacts this legislation would have on total usage of operator and family labor and of hired labor, and the cost of hired labor. Total hours of operator and family labor are estimated to increase slightly above their actual levels, while hours of hired labor are estimated to decline. Total hours of labor used in agriculture are estimated to decline, suggesting that the minimum wage legislation would probably result in higher levels of capital-labor substitution.

Based upon the estimated alterations in hours of hired labor, hours of operator and family labor, and the cost of hired labor, one can determine the impact of minimum wage legislation on financial structure of the farm sector. The simulation program was modified to reflect the above changes and the 1959-69 period was simulated. Results of these simulations are presented below.

Table 19–Simulated net changes in real estate and nonreal estate debt owed to commercial banks under actual and legal minimum reserve requirements, 1959–69

Year	Reserve requirements[1]				Simulated under assumed reserve requirements		Simulated under actual reserve requirements	
	Demand deposits		Time and savings deposits		Net change in real estate debt	Net change in nonreal estate debt	Net change in real estate debt	Net change in nonreal estate debt
	Actual	Assumed	Actual	Assumed				
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Mil. dol.*	*Mil. dol.*	*Mil. dol.*	*Mil. dol.*
1959	11.0	7.0	5.0	3.0	61.73	593.38	54.01	591.86
1960	11.0	7.0	5.0	3.0	111.44	531.66	103.46	531.50
1961	12.0	7.0	5.0	3.0	157.69	511.85	147.51	511.25
1962	12.0	7.0	4.0	3.0	214.13	609.16	204.78	609.09
1963	12.0	7.0	4.0	3.0	259.04	636.05	249.32	635.68
1964	12.0	7.0	4.0	3.0	275.30	402.97	264.72	402.46
1965	12.0	7.0	4.0	3.0	329.48	842.48	318.21	841.95
1966	12.0	7.0	5.0	3.0	299.57	810.46	285.83	809.54
1967	12.0	7.0	6.0	3.0	303.01	660.04	285.68	658.83
1968	12.5	7.0	6.0	3.0	333.89	920.99	313.61	919.79
1969	12.0	7.0	6.0	3.0	271.01	1,093.19	249.24	1,092.20
Total . . .	----	---	---	---	2,616.29	7,612.23	2,476.37	7,604.15

[1] Reserve requirements are for country banks. Assumed reserve requirements represent the legal minimum reserve requirement that the Federal Reserve Board could have required by law. Effective November 9, 1972, Federal Reserve regulation D was altered so that reserve requirements are based on a member bank's net demand deposits, not on its geographic location. Thus the classification "county banks" no longer exists. In addition, reserve requirements on demand deposits were lowered for banks with under $100 million in net demand deposits. Thus, as of December 31, 1972, most banks which were formerly classified as county banks had reserve requirements on demand deposits lower than the ones actually in effect from 1959 through 1969. However, for all banks the reserve requirements on demand deposits as of December 31, 1972, were still higher than the assumed legal minimum of 7 percent used above.

Table 20—Actual and assumed wage rates and hours of labor used in agriculture, 1959-69

Year	Cash wage rate per hour for hired farm laborers		Man-hours of farm labor hired		Man-hours of operator and family farm labor		Total hours of labor used in agriculture		Assumed increase in hired labor expense
	Actual	Assumed legal minimum	Actual	Assumed[1]	Actual	Assumed[2]	Actual	Assumed	
	Dollars	*Dollars*	*Million*	*Million*	*Million*	*Million*	*Million*	*Million*	*Million dollars*
1959 . . .	0.80	1.00	3,209	2,968	7,092	7,198	10,301	10,166	401
1960 . . .	0.82	1.00	3,173	2,964	6,622	6,709	9,795	9,673	362
1961 . . .	0.83	1.15	3,196	2,827	6,204	6,347	9,400	9,174	598
1962 . . .	0.86	1.15	3,071	2,761	5,908	6,027	8,979	8,788	534
1963 . . .	0.88	1.25	3,023	2,642	5,641	5,739	8,664	8,381	643
1964 . . .	0.90	1.25	2,891	2,554	5,303	5,427	8,194	7,981	591
1965 . . .	0.95	1.25	2,686	2,432	5,089	5,185	7,775	7,617	488
1966 . . .	1.03	1.25	2,504	2,344	4,877	4,939	7,381	7,283	351
1967 . . .	1.12	1.40	2,295	2,123	4,974	5,049	7,269	7,172	402
1968 . . .	1.21	1.60	2,264	2,045	4,741	4,833	7,005	6,878	533
1969 . . .	1.33	1.60	2,160	2,028	4,535	4,599	6,695	6,627	372

[1] Based upon an estimated price elasticity of demand for hired farm labor of −0.30.
[2] Based upon an estimated elasticity of substitution of −0.20.

Total net farm income of the farm sector for the 11-year period simulated was estimated to be $8.76 billion lower than that simulated under actual wage rates (table 21). What actions would farmers have taken to offset this decline in net farm income? First, it is estimated that nonfarm income of the farm population would have been $2.92 billion higher. This results from the fact that hourly earnings in the nonfarm sector would improve relative to operator labor returns in agriculture. This provides a greater incentive to work part time at nonfarm occupations. However, the substitution of nonfarm income for net farm income compensates for only 33.3 percent of the decline in net farm income. Farm operators would also respond to the decline in net farm income by increasing their level of debt. As shown in table 21, the enactment of minimum wage legislation is estimated to cause a slight reduction in real estate debt and a substantial increase in nonreal estate debt. The increase in nonreal estate debt can be used to support increased use of laborsaving technology. The stock of machinery is estimated to be $3.37 billion higher under the assumed minimum wage rates. Total debt outstanding is estimated to increase by $3.33 billion, or 39.2 percent of the decline in net farm income. Reductions in proprietor consumption also result from the decrease in net farm income. Proprietor withdrawals are estimated to decline by $5.53 billion (table 21). Because a decline in proprietor withdrawals and an increase in nonfarm income offset the decline in net farm income, proprietors' equities are estimated to be only $0.58 million lower under minimum wage rates.

In summary, the major effects of minimum wage

Table 21—Selected simulated values under actual wage rates and wage rates controlled by minimum wage laws, 1959-69

Item	Actual wage rates	Minimum wage rate laws
	Billion dollars	
Total net farm income, 1959 through 1969	154.24	145.48
Total nonfarm income, 1959 through 1969	106.26	109.18
Total net change in real estate debt, 1959 through 1969	17.18	16.31
Total net change in nonreal estate debt, 1959 through 1969, excluding CCC loans	18.17	22.34
Farm real estate debt outstanding, January 1, 1970.	28.31	27.44
Nonreal estate farm debt outstanding, January 1, 1970.	30.87	35.04
Value of farm machinery and equipment, January 1, 1970.	34.58	37.95
Proprietors' equities, January 1, 1970.	252.42	251.84
Proprietors' withdrawals, 1959 through 1969	261.18	255.65

legislation for the farm sector are to lower consumption of farm operators and their families, reduce the man-hours of hired farm labor and increase the man-hours of operator and family labor used in agriculture, increase nonreal estate debt relative to real estate debt, encourage more nonfarm work by farm operators and their families, and finally to increase hired labor earnings from employment in agriculture. Clearly, farm operators are likely to oppose minimum wage legislation, while farm labor groups are likely to favor it.

Other Potentials for the Model

A preceding section used a given set of assumptions about time paths of exogeneous variables to generate a projected farm income statement, balance sheet, and SAUF statement to 1980. A useful addition to this type of analysis is to vary the assumptions which govern the time path of exogenous variables. This allows one to more accurately determine the sensitivity of projected results to the underlying assumptions. While several modifications to time paths of exogenous variables were presented, there is almost an unlimited number of additional modifications which could be tested.

The counterfactual simulations presented earlier were chosen to indicate the versatility of the simulation model as well as to provide information on questions believed to be of importance. The question of minimum wage laws dealt with a broad general question, while reductions in reserve requirements on demand and time deposits at country banks dealt with rather specific questions about the rules under which one financial intermediary operates. One could investigate a host of other counterfactual simulations. Included in this set of questions are: What would be the impact on financial structure in the farm sector of (a) a zero level of capital appreciation of farm real estate assets, (b) a constant percentage unemployment level, (c) alterations in the relationships between farm and nonfarm sector interest rates, (d) alternative levels of nonfarm wage rates, (e) alteration of the level of deposits at country banks, (f) alteration of the supply of funds from life insurance companies, and (g) attainment of parity prices through the control of technological innovation and adoption? While time and space do not allow one to consider these questions here, the array of questions does indicate potential areas of applications of the model.

LIMITATIONS OF THE MODEL

The results presented herein are conditioned by the underlying structure of the model. A number of limitations are attached to the model because of lack of data and because of the conceptual framework employed.

Data limitations affect both the level of aggregation and the functional form of specific equations. Data availability influences the level of aggregation for both transaction (row) and transactor (column) entries of the social accounts included in the model. Transaction entries of the SAUF statement are, for the most part, on a net basis. The use of these net figures disguises the inclusion of certain items. For example, gifts and inheritances are not explicitly listed as a source of funds in the SAUF statement. Yet they are implicitly included because net changes in holdings of physical and/or financial assets resulting from gifts and inheritances are included. While not explicitly listed, cash sales of assets are also included on a net basis. For the simulation model constructed here, transactor entries of the farm income statement, balance sheet, and SAUF statement are limited to U.S. aggregates. Thus the model cannot be used for interregional questions or comparisons of financial structure.

Besides the level of aggregation, the form of specific equations is also affected by data availability. As mentioned in earlier sections, there is frequently a problem in that a theoretical determinant of a dependent variable may not be adequately measured by existing data series. Several examples can be cited. Changes over time in nonfarm income of the farm population are likely to be influenced by changes in level of education. Data series are not adequate to measure this variable. Changes in the demand for real estate and nonreal estate debt are likely to be influenced by changes in liquidity preferences of borrowers. Again, no data series adequately measures this determinant of borrowing.

In several cases, the functional form of the equation is affected by lack of data. Conceptually, one would like to fit a simultaneous system of equations for all institutions supplying farm real estate loans. Statistically, this is not now possible because of inadequate data on interest rates on new loans. One would also like to fit a simultaneous system of equations for institutional and noninstitutional sources of nonreal estate credit. Again, inadequacy of data prevents such analysis.

There are also several limitations which result from the conceptual framework employed in constructing the model. The model as currently structured cannot be used to measure investment on a cost basis. Rather, it measures net investment as the change in market value of assets. For some purposes, a cost basis of measuring investment is superior to the market value basis.

The model does not account for potential simultaneity in the demand for assets and liabilities. Rather, the equations are structured so that the demand for debt is determined by, among other things, the returns generated by the assets. The demand for assets is determined by, among other things, the cost of borrowing. To include a simultaneous determination of demand for assets and liabilities, the equations would need to be structured so that the demand for debt is determined by, among other things, the demand for assets while the demand for assets would simultaneously depend upon the demand for debt.

Finally, the model takes as given the demand for and price of farm products. A useful addition would be to explicitly estimate a consumer demand equation. This would allow one to trace impacts of changes in consumer demand on farm financial structure.

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Validation of a simulation model in the strictest sense is not possible. Yet it is useful to determine the degree of accuracy of model estimates compared with a known historical series. For this purpose, the model was run for an 11-year period, 1959-69. Variables generated within the model for time period t − 1 were used in generating the estimates in time period t. Simulated farm income statements, balance sheet statements, and SAUF statements are presented in tables A-1 through A-3 respectively. Deviations between reported and simulated values are also presented. If the recursive nature of the model results in "compounding errors" one would expect the deviations to grow over time and signs on deviations to be the same year after year.

The deviations for gross farm income and cash receipts from marketings plus the value of products consumed directly do not trend either upward or downward (table A-1). Likewise, deviations between reported and simulated values of gross rental value of farm dwellings and net changes in inventories do not follow a trend, although the error for estimated net changes in inventories is quite substantial. None of the items included under gross farm expenditures, with the exception of depreciation of buildings and machinery, display a trend in the deviation between reported and simulated values.

The estimated depreciation of buildings was too high from 1960 through 1967, and too low thereafter. This result can be attributed to the method of obtaining the estimate for the total value of buildings. Total value of buildings at the end of the period was defined as the value of buildings at the start of the period, plus capital improvements and repairs, minus depreciation. Thus an error in the estimated total value of buildings in the first period can be reflected in estimated depreciation for the second year. The magnitude of the deviation between reported and simulated values for building depreciation is, however, not great. The same general comments apply to depreciation of farm machinery.

Estimated net farm income is derived from all other estimated values. Therefore, errors in other estimates will be reflected in the estimates of net farm income. The largest error in the simulated value of net farm income occurred in 1966 when estimated net farm income was roughly 4.8 percent higher than the reported value. There appears to be a tendency for the simulated value of net farm income to overstate the actual value. On average, however, simulated values were only about 0.2 percent above reported values.

On balance, it appears that the simulation model gives a realistic portrayal of the reported farm income statement. While the model is recursively updated, there does not appear to be a growing magnitude of error for any of the items simulated, except depreciation. Both gross income and net farm income, which appear in other equations in the model, have relatively low average absolute percentage errors. Therefore, errors in estimating the farm income statement are not expected to lead to substantial errors in the remainder of the model.

The balance sheet for the farming sector (table A-2) reveals a very low deviation between reported and simulated values. This is not unexpected, since equations estimating stock values typically give a better statistical fit than equations measuring net changes in stocks. Estimated stocks of financial assets were never off by more than $0.2 billion from reported levels. Estimated stocks of farm real estate assets were never off from reported levels by more than 3 percent and after 11 years were identical with reported levels.

The largest errors came in the estimates of nonreal estate assets, particularly crop and livestock inventories. Estimated crop and livestock inventories were higher than reported levels for every period covered by the simulation model. There are two reasons for this occurrence. First, for the year in which the simulation was started, the estimated stock was about $1 billion higher than the actual level. Since the following year's stock of crops and livestock was determined by adding (or subtracting if appropriate) the estimated net change for the year, the estimated value was consistently too large. A test run in which the simulation model was started one year later virtually eliminated this source of error. Second, net change in inventories is measured with FIS data whereas crop and livestock inventories are taken from BSFS data. These estimates are not consistent because the BSFS data include crops stored off farms and value inventories at year-end prices, while crops stored off farms are excluded and inventories are valued at average yearly prices in the FIS.

To make the estimates more consistent, the level of crops stored off farms was treated as exogenously determined. This should make the quantity of inventories valued by BSFS and FIS consistent. To derive the year-end stock of crops and livestock valued at year-end prices, the following procedure was used. First, the net change in inventories valued at average prices was estimated. To this was added the beginning stock of inventories plus the beginning stock of inventories multiplied by the percentage change in year-end prices. This procedure takes into account changes in year-end inventories due to changes in year-end prices. Quantity changes which result in year-end inventory changes, however, are valued at average yearly prices. This conversion from net

Table A-1 Simulated farm income statements, 1959-69[1]

Item	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	Million dollars										
Simulated											
Gross farm income	37,144	38,764	39,855	41,439	42,755	42,505	46,069	49,731	49,356	51,651	55,443
Cash receipts from marketings plus value of products consumed directly	34,696	35,562	35,994	37,222	38,573	38,170	40,268	44,166	42,943	45,197	48,908
Gross rental value of farm dwellings	1,916	1,974	2,036	2,103	2,174	2,249	2,330	2,416	2,508	2,606	2,710
Net change in inventories	-150	527	331	368	313	-96	1,008	-128	827	386	31
Government payments[2]	682	702	1,493	1,747	1,696	2,181	2,463	3,277	3,079	3,462	3,794
Gross farm expenditures	26,203	26,555	27,167	28,122	29,343	29,654	31,085	32,692	34,581	36,368	38,699
Cash operating expenses plus net rent to nonfarm landlords	19,850	20,057	20,408	21,041	21,881	21,812	22,865	23,925	25,116	26,383	28,145
Interest on farm mortgage debt	577	638	700	776	871	967	1,099	1,224	1,337	1,492	1,621
Taxes on farm property	1,466	1,455	1,505	1,595	1,702	1,816	1,925	2,108	2,360	2,506	2,687
Depreciation of farm buildings	1,059	1,127	1,188	1,244	1,297	1,345	1,388	1,430	1,474	1,514	1,552
Depreciation of farm machinery	3,071	3,096	3,179	3,275	3,397	3,516	3,605	3,797	4,079	4,253	4,469
Accidental damage	180	183	187	191	195	199	202	207	214	219	225
Net farm income	10,941	12,209	12,688	13,318	13,412	12,850	14,984	17,040	14,775	15,283	16,744
Deviation from actual											
Gross farm income	416	-333	257	415	139	-758	-149	-72	301	-497	-471
Cash receipts from marketings plus value of products consumed directly	133	-158	271	210	-159	-7	-105	-55	495	-247	-930
Gross rental value of farm dwellings	41	7	-24	-24	-13	-26	-30	-64	-27	20	116
Net change in inventories	242	-184	10	228	310	-724	-14	47	-168	-270	343
Government payments	------	------	------	------	------	------	------	------	------	------	------
Gross farm expenditures	-97	-203	-42	517	345	-173	-152	714	194	-150	-22
Cash operating expenses plus net rent to nonfarm landlords	55	-79	217	807	727	181	66	887	295	-375	-495
Interest on farm mortgage debt	-5	-10	-14	-17	-25	-15	-22	-19	6	-15	-19
Taxes on farm property	-65	47	92	89	61	17	18	0	-85	20	66
Depreciation of farm buildings	-82	-128	-177	-158	-141	-124	-95	-48	-3	87	197
Depreciation of farm machinery	22	-6	-127	-173	-277	-268	-161	-85	-15	141	202
Accidental damage	-22	-28	-33	-31	0	35	43	-20	-2	-7	27
Net farm income	513	-130	299	-103	-206	-584	3	-787	107	-141	-216

[1] Actual values can be found by adding simulated values and corresponding deviations.

[2] Taken as given, not simulated.

Table A-2–Simulated balance sheets for the farming sector, 1959-69[1]

Item	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	Billion dollars										
Simulated											
Real estate assets	126.6	131.6	138.1	146.4	154.2	163.0	174.3	186.0	193.2	201.7	208.2
Nonreal estate assets	55.8	57.3	59.4	62.0	62.7	62.7	67.8	69.0	71.2	75.3	80.2
Crops and livestock	24.1	24.8	26.2	27.8	27.5	26.8	30.3	29.2	30.1	32.4	34.9
Machinery and motor vehicles	22.0	22.6	23.3	24.3	25.1	25.8	27.3	29.4	30.7	32.3	34.6
Household equipment and furnishings	9.8	9.8	9.9	10.0	10.0	10.0	10.2	10.4	10.5	10.6	10.7
Financial assets	18.2	18.1	18.2	18.9	19.3	19.9	20.6	21.0	21.7	22.5	23.3
Demand deposits and currency	6.3	6.0	5.8	5.9	5.9	5.9	6.1	6.0	6.0	6.3	6.4
Time and savings deposits	2.9	2.9	2.9	3.3	3.5	3.8	4.1	4.5	4.8	5.2	5.5
Other reported[2]	9.0	9.3	9.5	9.7	9.9	10.2	10.4	10.5	10.8	11.0	11.4
Total	200.6	207.0	215.6	227.3	236.1	245.5	262.7	276.0	286.0	299.5	311.6
Liabilities:											
Real estate debt	12.0	12.9	14.0	15.4	17.1	19.1	21.3	23.3	25.1	26.7	28.3
Nonreal estate debt	12.1	13.2	14.8	16.6	18.1	18.8	20.7	22.6	25.0	28.2	30.9
Proprietors' equities	176.5	180.9	186.9	195.2	200.9	207.6	220.7	230.1	236.0	244.5	252.4
Total	200.6	207.0	215.6	227.3	236.1	245.5	262.7	276.0	286.0	299.6	311.6
Deviations from actual											
Real estate assets	3.6	0.1	–0.1	–2.6	–2.1	–2.1	–1.8	–3.5	–0.1	0.9	0.0
Nonreal estate assets	–1.1	–3.0	–2.8	–3.7	–4.1	–4.9	–4.9	–2.8	–2.4	–1.9	–2.1
Crops and livestock	–1.2	–1.2	–1.0	–1.2	–1.9	–3.1	–3.1	–0.3	–1.7	–1.6	–0.5
Machinery and motor vehicles	0.2	–0.8	–1.0	–1.6	–1.0	–0.3	–0.2	–0.5	0.7	0.7	–0.5
Household equipment and furnishings	–0.2	–0.9	–0.8	–1.0	–1.1	–1.4	–1.6	–2.0	–1.5	–1.0	–1.1
Financial assets	0.0	–0.1	0.1	0.0	–0.2	–0.1	–0.2	–0.2	0.0	0.0	0.0
Demand deposits and currency	–0.1	–0.2	0.0	0.0	–0.2	0.0	–0.1	0.0	0.1	0.0	0.0
Time and savings deposits	0.0	0.0	0.1	0.0	0.0	–0.1	0.2	–0.2	0.0	0.0	0.0
Other reported	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total	2.5	–3.9	–2.7	–6.3	–6.3	–7.1	–6.9	–6.5	–2.4	–1.0	–2.0
Liabilities:											
Real estate debt	0.1	–0.1	–0.1	–0.2	–0.3	–0.2	–0.1	0.0	0.4	0.4	0.1
Nonreal estate debt	0.6	0.2	0.0	–0.1	0.0	–0.2	–0.3	–0.2	–0.1	–0.7	–1.2
Proprietors' equities	1.8	–3.1	–2.7	–5.9	–6.0	–6.6	–6.5	–6.3	–2.8	–0.6	–0.9
Total	2.5	–3.0	–2.7	–6.3	–6.3	–7.1	–6.9	–6.5	–2.4	–1.0	–2.0

[1] Actual values can be found by adding simulated values and corresponding deviations.
[2] Taken as given, not simulated.

Table A-3 Simulated sources-and-uses-of-funds statements, 1959–69[1]

Item	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	Million dollars										
Simulated											
Sources:											
Net farm income	10,911	12,209	12,688	13,318	13,412	12,850	14,984	17,040	14,775	15,283	16,744
Nonfarm income	9,881	9,124	8,045	9,094	8,803	9,982	9,326	9,014	10,095	10,798	11,794
Capital consumption	4,130	4,223	4,367	4,519	4,694	4,861	4,993	5,227	5,553	5,767	6,021
Net change in farm real estate debt	933	900	1,116	1,419	1,702	1,968	2,156	1,963	1,769	1,671	1,586
Federal land banks	315	235	203	321	390	515	504	561	489	446	541
Commercial banks	54	103	148	205	219	265	318	286	286	314	249
Life insurance companies	113	169	231	368	159	529	587	437	320	222	96
Individuals and other	399	318	449	506	586	644	734	724	725	732	738
Farmers Home Administration[2]	51	45	85	20	17	14	12	−46	−49	−43	−38
Net change in nonreal estate farm debt	924	847	1,162	1,582	1,641	1,046	2,046	2,179	2,078	2,035	2,632
Production credit assocations (+FICB)	140	163	204	252	267	203	361	409	419	531	666
Commercial banks	592	532	511	609	636	402	842	810	659	920	1,092
Nonreporting creditors[2]	200	130	370	660	700	390	770	940	940	560	919
Farmers Home Administration[2]	−8	22	77	60	38	50	73	20	61	24	−37
Capital appreciation of real estate	854	3,727	5,183	6,963	6,517	7,517	10,036	10,304	5,889	7,166	5,177
Total	27,693	31,330	32,561	36,894	36,770	38,224	43,541	45,690	40,161	42,720	43,954
Uses:											
Capital expenditures on nonreal estate assets	3,253	3,724	3,899	4,195	4,285	4,190	5,014	5,921	5,384	5,875	6,750
Net change in crop and livestock inventories	−150	527	331	368	313	−96	1,008	−128	827	386	31
Net change in financial assets	−986	−87	37	709	447	574	715	404	633	851	759
Demand deposits and currency	−607	−340	−200	150	−28	33	163	−54	8	275	50
Time and savings deposits	−180	−47	37	359	275	242	352	358	325	376	309
Other reported[2]	−200	300	200	200	200	300	200	100	300	200	400
Total investment in real estate assets	2,192	5,025	6,477	8,259	7,811	8,794	11,338	11,653	7,221	8,492	6,524
Proprietor withdrawals (calculated residually)	23,384	22,142	21,817	23,363	23,913	24,762	25,437	27,876	26,096	27,115	29,891
Total	27,693	31,330	32,561	36,894	36,770	38,224	43,541	45,690	40,161	42,720	43,954
Deviation from actual											
Sources:											
Net farm income	513	−130	299	−103	−206	−584	3	−787	107	−141	−216
Nonfarm income	−2,831	−2,271	−502	−899	−293	−677	719	1,450	786	1,031	981
Capital consumption	−60	−134	−304	−331	−418	−392	−256	−133	−19	232	366
Net change in farm real estate debt	58	−162	−37	−150	−66	122	136	152	415	−18	−318
Federal land banks	−46	−31	61	−100	−132	−110	49	113	160	72	49
Commercial banks	65	−43	−49	63	54	44	−48	−82	87	1	8
Life insurance comanies	45	−14	−44	−138	70	−22	−73	−25	6	1	−126
Individuals and other	−7	−73	−5	25	82	211	209	119	163	−93	−249

Farmers Home Administration[2]	------	------	------	------	------	------	------	------	------	------	------
Net change in nonreal estate farm debt	179	−405	−221	12	52	−97	−200	92	182	−691	−442
Production credit associations (+FICB)	112	−46	−34	−43	15	−32	−45	45	103	−220	40
Commercial banks	67	−359	−187	55	37	−64	−155	47	79	−472	−482
Nonreporting creditors[2]	------	------	------	------	------	------	------	------	------	------	------
Farmers Home Administration[2]	------	------	------	------	------	------	------	------	------	------	------
Capital appreciation of real estate	3,516	−3,527	−183	−2,463	483	83	364	−1,504	3,411	1,034	−277
Total	1,375	−6,629	−947	−3,924	−449	−1,544	767	−694	4,882	1,447	296
Uses:											
Capital expenditures on nonreal estate assets	−69	−1,011	−965	−1,135	−670	−487	−826	−1,172	−190	−1,120	−1,949
Net change in crop and livestock inventories	242	−184	10	228	310	−724	−14	47	−168	−270	343
Net change in financial assets	−14	−113	263	−109	−247	126	85	96	367	149	141
Demand deposits and currency	−93	−60	210	−50	−172	167	−63	64	92	−75	50
Time and savings deposits	−20	57	63	−59	−75	−42	−52	−58	175	24	−9
Other reported[2]	------	------	------	------	------	------	------	------	------	------	------
Total investment in real estate assets	3,608	−3,525	−177	−2,459	489	6	262	−1,653	3,379	1,008	−224
Proprietor withdrawals (calculated residually)	−2,392	−1,797	−78	−459	−330	−465	1,259	1,952	1,494	1,681	1,782
Total	1,375	−6,629	−947	−3,934	−449	−1,544	767	−694	4,882	1,447	296

[1] Actual values can be found by adding simulated values and corresponding deviations.

[2] Taken as given, not simulated.

changes in inventories valued at average yearly prices to stocks of inventories valued at year-end prices is not exact. But the magnitude of the error does not cause substantial errors in estimated levels of year end stocks.

The estimated level of household furnishings and equipment was too high for each year. This can be traced to the equation from which this estimate is derived. The value of household furnishings and equipment in year t was estimated as a function of the value in t − 1. Thus if the estimate in t − 1 is too high, the estimate in year t is also likely to be too high. However, the average error is not great in the 11-year period simulated. Errors resulting from household furnishings and equipment estimates are of course reflected in estimates of total assets and proprietors' equities.

Table A-3 presents simulated SAUF statements for 1959–69. Several of the items such as net farm income, net change in crop and livestock inventories, and depreciation have been discussed earlier. Estimated levels of nonfarm income of the farm population were too high from 1959 through 1964, and too low thereafter. The average deviation was roughly 12 percent of reported values. If one is interested strictly in a predictive equation, better results can be obtained by making nonfarm income in year t a function of nonfarm income in year t − 1.

One feature of the SAUF statement in table A-3 is the disaggregation of net changes in debt by lending institution. Aggregated net changes in real estate and nonreal estate debt are generally better than the estimates for specific institutions. Consider, for example, the estimated net changes in real estate debt for 1961. The deviation for the aggregate net changes in real estate debt was -$37.0 million. Yet for three of the four institutions covered, the absolute deviation was greater than $37.0 million. However, negative deviations for life insurance companies and commercial banks were offset by a positive deviation for Federal land banks. This suggests that aggregate net changes can be determined more accurately than the individual dispersions of these net changes. One explanation of this result is that alternative sources of real estate debt are, to some degree, substitutes for each other. Since the equations derived earlier could not measure the interactions among lending institutions, a change in relationships among the institutions could affect the market share of each, leaving the total quantity unchanged.

While the components of table A-3 may appear to have a rather high error, two points need to be considered. First, simulated total sources of funds were on average only about 4.5 percent off the reported levels. Second, the items in the table represent, to a large extent, net flow figures. In converting these net flow figures to stock values, the percentage error on stock values is much less, as evidenced by results in table A-2. Therefore, the SAUF statement portion of the simulation model appears to be sufficiently accurate for the simulation tests undertaken. The results do indicate, however, that the accuracy of disaggregated flows of funds is likely to be less than the accuracy of aggregated figures.

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