Theoretical Considerations Concerning the Supply of and

Demand for Long Term Credit in Agriculture[1]

Leon F. Hesser*[2]

Capital (including land and buildings) employed in American agriculture
is financed by:

a.  Equity of farm operators,

b.  Equity of nonfarm landlords and other owners of farm property,

c.  Credit.

What is the significance of credit in financing inputs in agriculture?
What are the underlying structural relationships of supply and demand in the
agricultural credit market?  What are the effects of changes in national income
and saving on the supply of credit to agriculture?  What are the effects of
changes in realized farm income on the demand for credit?  What would be the
effects of subsidizing or restricting credit to agriculture?

Virtually no theorems or empirical evidence exist to help answer these
questions or to guide agricultural credit policy decisions.  In this paper,
we shall draw upon theories of interest, capital and investment, and factor
markets to develop a conceptual model of the supply and demand for long term

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*   Agricultural Economist, Farm Economics Research Division, USDA.

[1]  This paper was presented as a Ph.D. Thesis Seminar with the Agricultural
Economics Department, Purdue University, on February 17, 1961. It represents
early thinking on a research project and is, therefore, subject to revision.

[2]  Dr. G. Edward Schuh has given invaluable assistance in helping the author
to precipitate ideas from random thoughts.

agricultural credit. We will then propose an econometric model that purports to estimate the structural relationships of the model as the first step in a broader analysis of the agricultural credit market.

## Classification of Agricultural Credit

In recent decades the proportion of the nation's farm capital financed by credit has varied roughly between 10 and 20 percent. [3/]

What do we mean by credit?

Credit is the extension of goods, services, or capital funds by one individual or firm to another individual or firm upon the latter's promise to pay a specified amount at a specified later date (or dates). Generally, credit in agriculture takes one of the following forms:

1. Open account. A farm proprietor (farm operator, landlord, or other owner of farm assets) buys goods or services from a merchant or dealer on open account.

2. Formal merchant credit. A farm proprietor buys goods or services from a merchant or dealer and gives a secured or an unsecured note for complete or partial payment.

3. Capital loanfunds. A farm proprietor obtains capital loanfunds from an individual or a lending institution in exchange for a secured or an unsecured note. The funds can then be used to buy goods (including real estate) or services. (Within this classification we will include the sale of farm real estate by one party to another with the buyer giving a mortgage and a note to the seller. The effect is the same as if the seller had

[3/] As calculated from the January 1 estimates of The Balance Sheet of Agriculture (ARS, USDA, annual). These are estimates of the "stock" of credit at a period in time. They do not consider the "flow" of credit during the year.

extended loanfunds to the buyer and then accepted them as payment for the real estate. The same reasoning could be used to include formal merchant credit as capital loanfunds, but it is convenient to make this distinction.) Credit may also be classified in either of these two ways:

1. Real estate credit and non real estate credit

2. Short-term credit, intermediate-term credit and long-term credit.

The latter is merely a further breakdown of the former. Real estate and long-term credit are essentially synonymous. Non real estate credit may be differentiated into short- and intermediate-term credit. Short-term credit may be defined as credit extended for one year or less. Then intermediate-term credit would be all non real estate credit with terms longer than one year (usually not more than 5 to 7 years).

Combining these classifications of credit, we can show them graphically as in Figure 1. This paper will be concerned with long-term capital loanfunds.
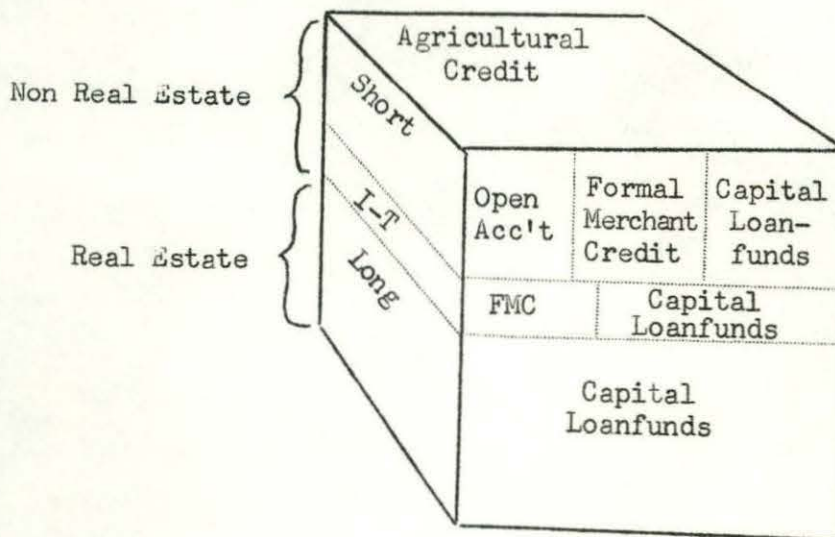


Figure 1. Classification of Agricultural Credit.

Sources of Long-Term Capital Loanfunds

On January 1, 1960, farm real estate loans in the U.S. were held as follows:

| Source | Percent |
|--------|---------|
| Individuals | 41 |
| Insurance companies | 23 |
| Federal land banks | 19 |
| Banks | 13 |
| Farmers Home Administration | 4 |
| Total | 100 |

These percentages have fluctuated, historically.

Some, if not most, of the real estate paper held by individuals is a result of their having sold real estate and having accepted mortgages as partial payment.

Loanable funds of insurance companies are their liabilities to policyholders. Asset portfolios of insurance companies may contain farm and nonfarm real estate mortgages, government bonds, state and local (municipal) bonds, corporate bonds and equity stocks. Insurance companies have different policies with respect to farm real estate mortgages.

Federal land bank associations obtain funds by "discounting" farm mortgages with the Federal land banks (twelve in the U.S.). Federal land banks in turn obtain funds through the central money markets by selling consolidated Federal land bank bonds.

Loanable funds of banks are a portion of the liabilities to their depositors - demand, time, or savings deposits. Most banks maintain only a small proportion of their assets in farm real estate mortgages.

Approximately 3/5 of the outstanding volume of long-term (farm ownership) loans of the Farmers Home Administration has its source directly with the government. The other 2/5 is advanced by private lenders and insured by the government.

## Theoretical Considerations

Studies of agricultural credit are traditionally characterized by an institutional approach with much description and few or no theorems; a body of theory that applies specifically to aggregate agricultural credit has not been developed. In developing a theoretical framework in this paper we shall build upon, or borrow from, established interest theory, factor market theory, and capital and investment theory.

### Available Theories

#### Interest Theory

Somers (8) has summarized the various "schools" of interest into four rather distinct theories:

I. Non-monetary theories of interest (Fisher)

    A. Marginal productivity of capital (Knight)

    B. Time preference (Pigou, Fetter)

II. Monetary theories of interest

    A. Liquidity preference (Keynes)

    B. Loanable funds (Hicks, Ohlin, Robertson, Haberler, Viner)

The monetary theories, particularly the loanable funds theory, appear to have more potential as an aid in defining the conceptual model for this study. This approach suggests that the rate of interest is determined by the supply and demand for loanable funds (demand and supply of securities). Implicit in this theory are concepts of productivity, thrift, liquidity preference, and changes in the quantity of money.

## Factor Market Theory

Credit is not a factor of production, per se, but rather is one means of financing the classical tripartite - land, labor and capital. The demand for credit is some function of the demand for factors of production, which is derived from the expected demand for the product. It is also a function of current equity, realized farm income, and the immediate alternative ways of gaining control of resources, such as renting land or purchasing land by contract.

## Capital and Investment Theory

Investment of resources is an important part of the demand for credit. Capital and investment theory offers a framework that is helpful, conceptually, in understanding changes in the amount of investment (changes in the rate of change in the stock of capital employed) in agriculture. A three-dimensional diagram will illustrate (Figure 2).

One horizontal axis represents the stock of capital at a point in time; the other horizontal axis represents the flow of investment per unit of time. The vertical axis represents the rate of interest. Curve AB is the marginal efficiency of capital (the internal rate of return on the existing stock of capital) and curve AC is the marginal efficiency of investment (the internal rate of return on new additions to the existing stock of capital).[4]

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[4] The idea of showing MeK and MeI in this manner was presented by A. B. Lerner in a seminar at Purdue University, January 31, 1961.
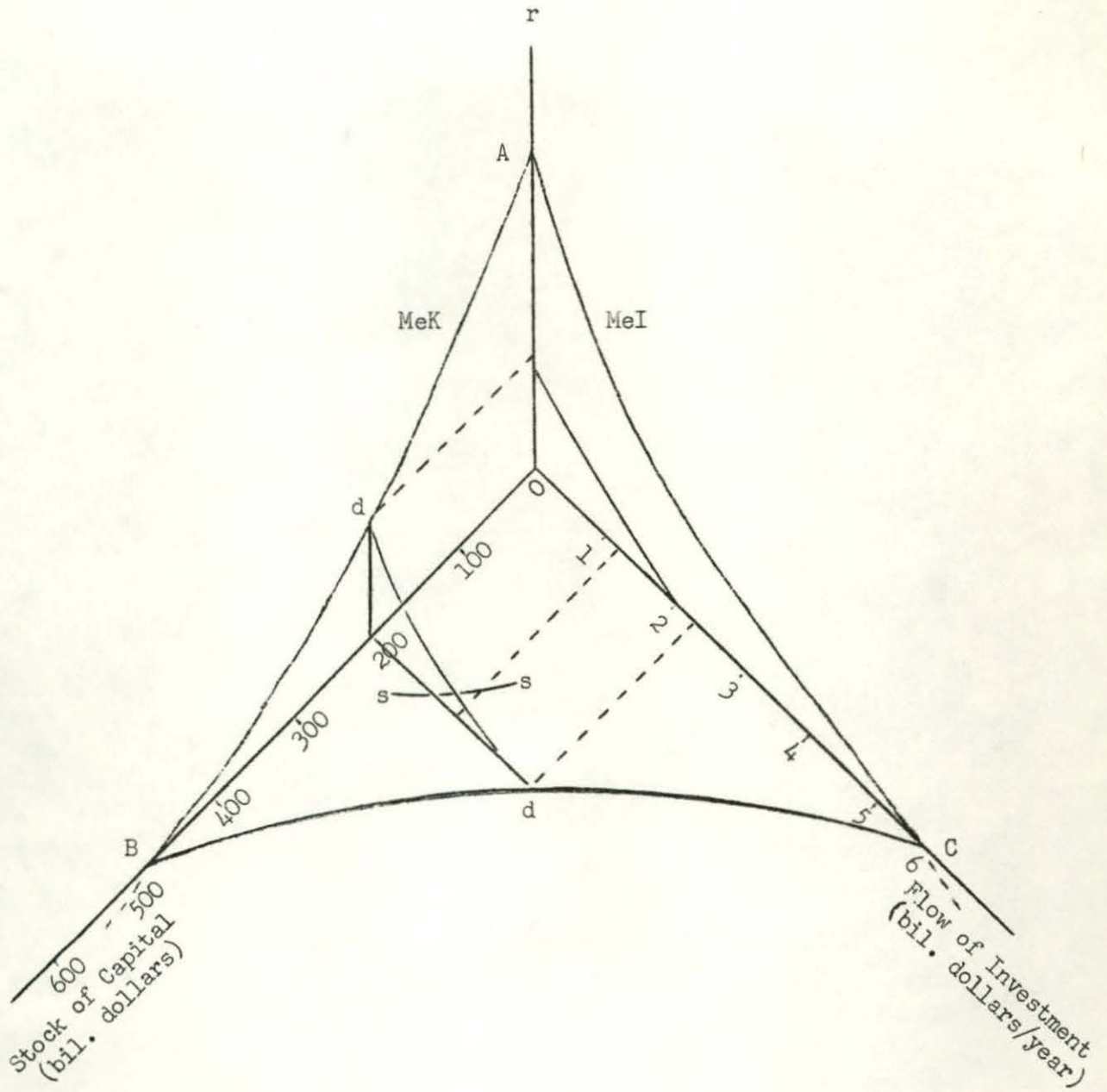
Figure 2.

## Extensions of Available Theory

U.S. agriculture may be plugged into Professor Lerner's model (Figure 2). The "partition" depicts U.S. agriculture for the year 1959. Capital employed January 1, 1959, was $202.3 billion. Net investment during the year was $1.3 billion (ARS, USDA estimates).

For any short-run decision period, the only relevant part of the surface ABC is the curve d-d, which we will call the demand for net investment funds. Curve s-s represents some sort of a supply-of-investment-funds function which, together with curve d-d, determines the amount of net investment during the relevant time period.

## Conceptual Model: Demand and Supply of Agricultural Credit

Embodied in curve d-d is a demand for credit and embodied in curve s-s is a supply of credit. In addition to the supply of credit implied in s-s, there is a supply of internal funds which is derived from realized farm income. It may be hypothesized that the supply of internal funds for investment is relatively interest inelastic in the usual range of interest rates. It is determined primarily by farm income.

Figure 3 shows a cross-sectional view of curve d-d. Curve $S_c$ is a hypothetical supply of credit to agriculture. The demand for credit $(D_c)$ is a function of the demand for investment (d-d) and realized farm income $(Y)$. (Assume that net investment equals gross investment; i.e., ignore capital depletion. Assume also that the level of investment is geared to long-term expectations and is therefore relatively independent of the level of current realized farm income — a value-added concept. The latter assumption guarantees stability, relative to current realized farm income, of the demand for investment

curve and assures a determinate solution.)  As realized farm income increases $(Y_1 < Y_2 < Y_3 \ldots)$, the relevant demand-for-credit curve lies to the left.
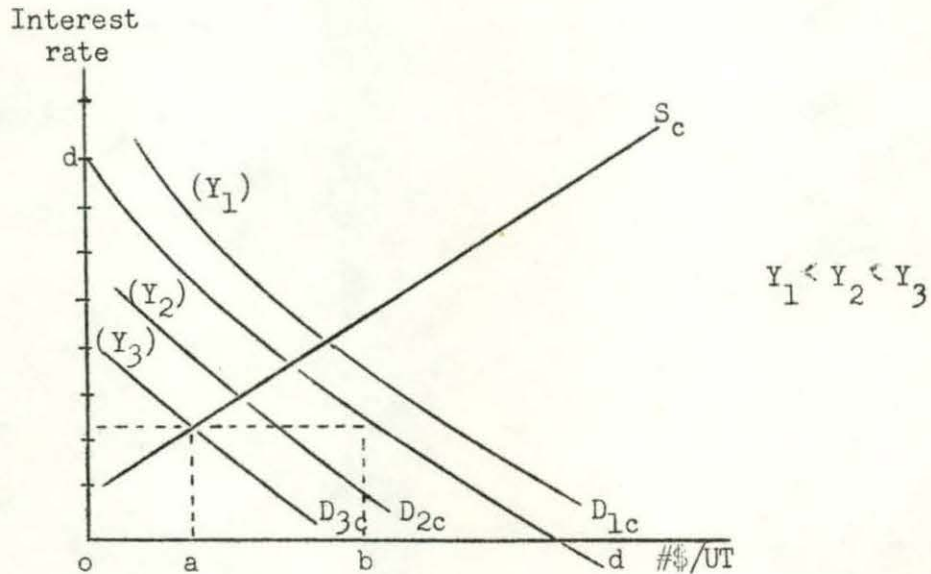


Figure 3.

If farm income is $Y_3$, the quantity of new credit (new additions to debt) during the relevant time period will be o-a, investment will be o-b, and the amount of internal funds invested will be a-b.

If farm income drops to $Y_2$, the relevant demand-for-credit curve is $D_{c2}$. The quantity of credit taken increases at a slightly higher rate of interest, the amount of investment decreases, and the amount of internal funds for investment decreases by virtue of the smaller income.

Ceteris paribus, a shift to the right of the supply function causes a larger quantity of credit to be taken at a slightly lower rate of interest. The amount of internal funds invested remains the same.

## Total Supply of Capital Loanfunds in the Economy

Although the categories are not always clearly defined, the loanable funds market for the U.S. may be classified:

    I.  Long-term loanfunds
        A.  Farm
        B.  Nonfarm
            1.  Corporate bonds
            2.  Government bonds
                a.  State and local
                b.  Federal

    II. Short term loanfunds
        A.  Farm
        B.  Nonfarm

Whereas the supply of total loanfunds may be relatively interest inelastic in the short run, the supply function for any of the sub-categories can be expected to be more elastic. Categories in which the volume per unit of time is a small portion of the total flow of loanfunds may be characterized by a supply function that is (relatively, if not perfectly) elastic. In a puristic model, assuming perfect mobility of funds among the categories, the supply function for any one category may approach an infinite elasticity. To the extent that perfect mobility is not true in the real world, the function will have some slope.

## Supply of Long-Term Loanfunds to Agriculture

In general, the supply function for a factor to an industry may be defined as the relationship between the price of the factor and the maximum quantity offered to the industry per unit of time under specified conditions. The supply function of long-term capital loanfunds to U.S. agriculture may be expressed as the relationship between the rate of interest and the maximum quantity of loanfunds extended by the economy per unit of time under _ceteris_

paribus conditions (i.e., constant supply and demand functions for total loanfunds in the economy).

We may state as a conceptual hypothesis that the supply function for long-term capital loanfunds to agriculture has a slope greater than zero.

For what reasons may we expect this to be?

I. Increasing risk

The "principle of increasing risk" assumes importance to investors if the quantity of the flow of funds offered to the industry during the relevant period of time is a significant portion of the stock of debt (or, more particularly, of the stock of assets) of that industry. In other words, if the quantity of funds offered stands to reduce the equity ratio of agriculture, greater risk is assumed by investors as successively larger quantities of loanfunds are offered to that industry.

II. Immobility of funds

Several a priori reasons suggest that loanfunds are not perfectly mobile among the categories outlined above.

A. Cost of shifts. Costs are involved in liquidating certain assets and "investing" in others. Hence, to induce an insurance company, for example, to shift a larger and larger proportion of its portfolio to agricultural paper will require successively higher interest rates.

B. Diversified portfolios are associated with reduced risk. To the extent that lenders have this image, successively higher rates are required to induce them to load their portfolios with assets of a particular nature.

C. Preferences of investors. Lenders may prefer to invest in some industries because they have more knowledge about those industries,

and vice versa. However, successively higher rates, say for agriculture, may overshadow the aversion stemming from lack of knowledge about agriculture.

Lenders may have preferences which stem from different evaluations of the risk inherent in an industry.

D. Imperfect knowledge of alternatives. Loanfunds may be immobile because lenders lack knowledge of investment alternatives.

## III. Institutional Rigidities

Interest rates of some lenders, particularly banks, tend to be more "sticky" than rates of, say, insurance companies. Banks (and perhaps others) tend to ration credit by means other than the interest rate.

This institutional phenomenon has been cited as evidence that the supply of credit to agriculture is perfectly interest elastic, with limitations on the absolute quantity being directed by institutional forces rather than by price. However, it may be hypothesized that whereas the supply function for any one group of lenders may be interest elastic, the aggregate of all lenders produces a function with a positive slope; as the aggregate demand for agricultural credit increases and the institutional limits of a particular group of lenders is reached, borrowers call upon another group of lenders who may exhibit more interest flexibility. As the demand presses more and more on the latter group, the rate of interest rises, effecting a positive supply function. In essence, while the supply relation for the individual lender or institution may be perfectly elastic, aggregation results in a relationship with a positive slope.

### Shifters of the Supply Curve

The supply of credit to agriculture is hypothesized to be a function of the (relative) rate of interest. The prime shifter of the curve would be changes in

the supply of total loanfunds in the economy. Total loanfunds are a function of:

A. Personal saving, which is a function of:

    1. Personal income

    2. Propensity to consume

B. Hoarding and dishoarding

C. Changes in the supply of money (Federal Reserve monetary policy).

To the extent that B and C are constant, personal savings equal the supply of total loanfunds (ignoring business saving and capital depletion).[5]

## Demand for Credit by Agriculture

Shifters of the Demand Curve

Fundamentally, the demand for credit is a demand for resource control. It centers around the demand for investment, but is conditioned by the alternative means of gaining control of resources. For the individual farm manager, alternative ways of acquiring land resources are renting, purchase by contract, and mortgage financing. If in the aggregate the relative emphasis among these close substitutes changes over time, the demand for mortgage credit will have changed. The need to measure the changing relationships among these substitutes poses an empirical problem. Perhaps the number of rented acres and the number of farm sales by contract can be used as operational variables.

Other shifters of the demand-for-investment schedule, and the accompanying $D_c$ curves, are: (a) changing population, (b) changing technology, and (c) changing uncertainty conditions. These are reflected in, or summarized by, expected farm prices. As the operational variable for expected farm prices, we propose to construct a series using a technique developed by Cagan and Friedman.

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[5] R. G. Thomas, Our Modern Banking and Monetary System, Prentice Hall, 1957, 3rd edition, pp. 403-410.

Phillip Cagan developed a weighting pattern to estimate the expected rate of changes of prices during hyperinflations from the time series of past rates of change. The model that led to this weighting pattern was used by Milton Friedman, in studying consumption functions, to estimate permanent income from the incomes of prior years. The weighting pattern gives most weight to current income and successively declining weights to earlier incomes. In his final computation 17 terms (years) were retained in computing "expected" income. Starting with current income and going backward in time, the weights were: .330, .221, .148, .099, .067, .045, .030, .020, .013, .009, .006, .004, .003, .002, .001, .001, .001. The weights, of course, sum to unity. Friedman states that "the retention of as many as 17 terms is doubtless an excess of precision. It is dubious that the results would be appreciably affected by retaining, say, only 9 terms and adjusting the weights for them to sum to unity." [6]

We propose to use the weighting pattern developed by Friedman, using perhaps 9 terms, to estimate farmers' "expected" prices. The historical prices used in computing expected prices will be a ratio of the index of prices received for all farm products to the index of prices paid for items of production.

## Tentative Hypotheses

Demand for long-term agricultural credit is postulated to be:

a. A negative function of realized farm income,

b. A negative function of the rate of interest,

c. A positive function of expected prices,

d. A positive function of the number of land transfers,

f. A negative function of the number of rented acres,

g. A negative function of the number of sales of farms by contract.

[6] Friedman (3), pp. 146-7.

The supply of long-term capital loanfunds to agriculture is postulated to be:

    a.  A positive function of the rate of interest on long-term agricultural loans.

    b.  A negative function of the rate of interest on comparable nonfarm loans.

    c.  A positive function of the total supply of loanfunds in the economy.

    d.  A positive function of agriculture's percentage of equity.

## Statistical and Empirical Model

As in studies of supply and demand for a product, identification is a problem. To avoid obtaining a "mongrel" relationship rather than the true structural relationships, a simultaneous equations model is postulated - one equation for the demand for credit and one for the supply of credit.

The supply function (demand function) is defined as the relationship between the rate of interest and the maximum quantity of loanfunds extended (demanded) by the economy (by agriculture) per unit of time under _ceteris paribus_ conditions. The statistical model should contain the variables that are shifters of the curves when the _ceteris paribus_ conditions are relaxed.

A two-equation model is postulated in which the two endogenous variables - interest rate to agriculture and the volume of long-term credit extended - are assumed to be jointly or mutually determined, subject to the various exogenous variables. All variables enter the system linearly in either their observed or transformed values. Deflated values will be used as much as possible to reduce multicollinearity.

The suggested statistical model is:

Demand: $Y_1 = \alpha_1 + \beta_1 Y_2 + \gamma X_1 + \rho X_2 + \tau X_3 + \theta X_4 + \partial X_5 + \lambda X_6 + \mu$

Supply: $Y_1 = \alpha_2 + \beta_2 Y_2 + \phi X_8 + \eta X_7 + \pi X_9 + \mu$

where $Y_1$ = Volume of long-term credit to agriculture per year. (Farm

mortgage loans made or recorded, Ag. Finance Review.)

$Y_2$ = Current rate of interest on farm mortgages.

$X_1$ = Realized farm income. (Constructed from data in The Farm Income

Situation, AMS, USDA.)

$X_2$ = Expected agricultural prices.

$X_3$ = Number of farm transfers. (The Farm Real Estate Market, FERD,

USDA.)

$X_4$ = Real value of farm assets. (Balance Sheet of Agriculture, FERD,

USDA.)

$X_5$ = Number of rented acres.

$X_6$ = Number of farm sales by contract.

$X_7$ = Total supply of loanfunds in the economy. (Personal saving,

Goldsmith, Saving in the U.S.)

$X_8$ = Rate of interest on corporate securities.

$X_9$ = Agriculture's percentage of equity. (Balance Sheet of Agriculture.)

$Y_1$ and $Y_2$ are endogenous. All other variables are exogenous. The

constraints on the estimated coefficients are: $\beta_1 < 0$, $\gamma < 0$, $\rho > 0$,

$\tau > 0$, $\theta > 0$, $\partial < 0$, $\lambda < 0$, $\beta_2 > 0$, $\phi < 0$, $\eta > 0$, $\pi > 0$.

Using the counting rule to examine a priori identifiability, both

equations are over-identified. The supply equation has five over-identifying

constraints and the demand equation has two.

Theil-Basman estimating procedures will be used in estimating the equations. This means that each equation is estimated independently, but some of the constraints implied by the other equations are taken into account, thereby eliminating inconsistency bias.

## Annotated Bibliography

(1) Johnson, G. L., "Supply Function - Some Facts and Notions," Agricultural Adjustment Problems in a Growing Economy, E. O. Heady, H. G. Diesslin, H. R. Jensen, and G. L. Johnson, eds., Iowa State College Press, 1958.

Johnson summarizes the literature on aggregate agricultural supply response prior to 1958. His summary of the work of many prominent agricultural economists substantiates the conclusions that work on aggregate supply response has been inadequate. He stresses that to explain aggregate output, the primary interest is in the flow of resources between the farm and nonfarm sectors as contrasted with movements within the farm sector.

(2) Johnson, G. L., "The State of Agricultural Supply Analysis," Journal of Farm Economics, Vol. XLII, No. 2, May 1960.

In this paper, Johnson stresses the need for "an agressive program of data collection and compilation to provide measures of resources flows..." He also stresses the need for research on the supply functions for inputs to the agriculture sector.

(3) Friedman, Milton, A Theory of the Consumption Function, Princeton Univ. Press, 1957.

(4) Machlup, Fritz, The Stock Market, Credit and Capital Formation, Hodge and Co., London, 1940.

"The supply of credit is partly determined by political factors, and thus is not the result of the free play of forces... It is of the nature of credit

that it links up with the theory of capital formation on the one side and the theory of money on the other...

"It is a fact that agricultural credit becomes dearer in times when there is an active interest in industrial securities."

## Interest Theory

(5) Keynes, J. M., "The Theory of the Rate of Interest," The Lessons of Monetary Experience, 1937. (Reprinted in Readings in the Theory of Income Distribution, Blakiston and Co., Philadelphia, 1946.)

Keynes indicates the precise points of departure of his theory ("a general theory") from what he called the orthodox theory (" a limiting case", where full employment is assumed).

(6) Hicks, J. R., "Mr. Keynes and the 'Classics'; A Suggested Interpretation," Econometrica, 1937. (Reprinted in Readings, ibid.)

Hicks presents what he says might be called "a slight extension of Mr. Keynes' similar skeleton, (but) it remains a terribly rough and ready sort of affair."

(7) Robertson, D. H., "Mr. Keynes and the Rate of Interest," Essays in Monetary Theory, 1940. (Reprinted in Readings, ibid.)

Robertson states that "...the natural course seems to be to describe the rate of interest as the market price of the hire of ... loanable funds... This price, like other market prices can be conceived as emerging from the interaction of schedules of supply and demand, showing the amount of loanable funds which, at given hiring-prices, people are respectively willing to put on to, and to take off, the market during the slice of time selected for observation... We must not be surprised to find that these schedules are complicated things."

(8) Somers, H. M., "Monetary Policy and the Theory of Interest," _Quarterly Journal of Economics_, 1940-1941. (Reprinted in _Readings_, ibid.)

Besides summarizing and classifying interest theories to date, Somers "attempts to resolve the controversies...by setting up a system in which all four variants of interest theory - the two non-monetary and the two monetary variants - have a place."

(9) Modiglianai, Franco, "Liquidity Preference and the Theory of Interest and Money," _Econometrica_, 12 (1944).

Modiglianai, in building upon and criticising Keynesian theory, discusses the demand for money by individuals as an asset, $D_a$, (a stock - to hold, for contingencies, etc.) and the transaction demand for money, $D_T$ (a flow).

In his macrostatic system of equations, savings is a function of the rate of interest and income: $S = S(r,Y)$. "Our equation is a saving schedule and not a schedule of supply of loanable funds...(but) saving and lending coincide when the demand for money to hold is zero or constant."

(10) Tobin, J., "Liquidity Preference and Monetary Policy," _Review of Economic Statistics_, 29:124-131, 1947.

Tobin presents a statistical refutation of the hypothesis that the demand for cash balances is interest-inelastic.

(11) Latane, H. A., "Cash Balances and the Interest Rate - A Progmatic Approach," _Review of Economics and Statistics_, 36:456-460, 1954.

Latane is concerned with the interrelation of cash balances (M), national income (Y), and long-term interest rates on high-grade obligations (r). He tests four equations, including Modigliani's: $M = D_a(r) + D_r (Y)$. He concludes that the best fit was for the formula: $M/Y = c/r + d$, a modified quantity theory equation with a linear relationship between M/Y and 1/r. He concludes "that a

decline in rates has been associated with an increased demand for cash balances

at a given level of income."

(12) Horwich, G., "Money, Prices and the Theory of Interest Determination,"
Economic Journal, 67:625-43, 1957.

Horwich presents a model, representing the Keynesian classical synthesis,

which "integrates the stock-flow capital-market analysis...with a stock-flow

analysis of the supply and demand for money."

Studies in Capital Formation and Financing
(National Bureau of Economic Research)

(13) Grebler, Leo, et al, Capital Formation in Residential Real Estate:
Trends and Prospects, Princeton University Press, 1956.

(14) Tostlebe, A. S., Capital in Agriculture: Its Formation and Financing
Since 1870, Princeton University Press, 1957.

Tostlebe measured and analyzed the growth of farm capital for an 80 year

period, 1870-1950. The data are for the stocks of capital at 10-year intervals

until 1920, and for 5-year intervals thereafter. He presents "rough estimates"

of the uses and sources of new capital at 5-year intervals from 1900-1950. Most

of the new capital associated with the growth of capital has been financed by

farmers themselves from gross income. He states that "an essentially accurate

measure of capital supplied by external sources is the volume of farm debt."

One section is devoted to regional differences in creditor participation in

financing farm capital.

(15) Goldsmith, R. W., Financial Intermediaries in the American Economy Since
1900, Princeton University Press, 1958.

(16)  Ulmer, M. J., _Capital in Transportation, Communications and Public
      Utilities:  Formation and Financing_, Princeton University Press, 1959.

(17)  Robinson, R. I., _Postwar Market for State and Local Government Securities_,
      Princeton University Press, 1960.

"In most respects the market for state and local government securities is
quite different from the market for mortgages.  But these two markets share one
important characteristic:  a considerable fraction of each is still quite local
in character...thus insulated from some of the influences of central money
markets."  p. 28.

### Studies in Agricultural Finance
### (National Bureau of Economic Research)

(18)  Jones, L. A. and D. Durand, _Mortgage Lending Experience in Agriculture_,
      Princeton University Press, 1954.

Jones and Durand studied mortgage lending experience, with emphasis on the
inter-war period, to determine causes of farm mortgage distress.

(19)  Horton, D. C., _Patterns of Farm Financial Structure_, Princeton University
      Press, 1957.

Horton studied the relationship of the physical and economic features of
farms to the way they are financed.  He concluded that relatively large farms
make heavy use of external funds, drawing on landlords for equity and on outside
investors who operate as part of a broad capital market.