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THE DEMAND FOR AGRICULTURAL MORTGAGE CREDIT

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Credit: An Econometric Study," unpublished Ph.D. thesis, Purdue University, 1962.
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THE DEMAND FOR AGRICULTURAL MORTGAGE CREDIT

This paper is a partial report of research that is attempting to gain insights into the structural relationships describing the agricultural credit market. As such it attempts to examine one of the links in the chain of relationships that connect agriculture to the nonfarm sector of the economy. Time limitations will preclude a complete defense of the models, though we are hopeful of presenting enough to stimulate discussion of what is largely an exploratory study.

The Role of Credit in American Agriculture^{1/}

Credit has two basic uses. One use is as a means of financing new capital.^{2/} And although the volume of new farm capital financed with credit has usually been small compared to that financed by farmers themselves, it has sometimes been substantial.^{3/} Tostlebe has predicted that the proportion of agricultural capital financed by creditors will be considerably higher in the future.^{4/} This would be a continuation of the marked increase in creditor participation in capital formation since 1950.

^{1/} Some of the historical experience in the agricultural mortgage market is summarized in figures 1 and 2 and table 1 attached as an appendix.

^{2/} Machlup states, "It is 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." Fritz Machlup, The Stock Market, Credit and Capital Formation, Hodge and Co., London, 1940, p. 5.

^{3/} Tostlebe, Alvin S., Capital in Agriculture: Its Formation and Financing since 1870, National Bureau of Economic Research, Princeton University Press, Princeton, 1957, p. 19.

^{4/} Ibid, p. 36.

The second use of credit is for financing the transfer of ownership of assets. Although not contributing directly to the formation of new capital, credit in this role releases other funds for capital formation.

Particularly in the case of farm mortgage credit, to which this study is addressed, a third general use may be identified: the refinancing of existing debt. In this study no attempt is made to separate uses of credit. The model for the demand for farm mortgage credit is developed to incorporate economic forces affecting all uses, so that the flow of mortgage funds can be dealt with in a gross sense.

A Conceptual Model

A complete study of the market for farm mortgage credit would deal with at least three concepts of credit: the stock of debt outstanding; the annual gross flow of farm mortgage loans; and the net flow or loans closed less repayments. The theory used will be different depending upon which concept one is attempting to explain. The concepts, of course, are not independent of each other. Stock-flow considerations are an important part of a complete understanding of the credit market.

The concept of credit used in this study is the annual gross flow of farm mortgage loans, or the volume of farm mortgage loans closed during the year. The market for farm mortgage credit is probably manifested most directly in terms of loans closed, and distinguishing between the extension of credit and the repayment of debt permits a more complete analysis and understanding of forces at work in the market for credit.

The theory developed will therefore attempt to explain the gross flow of mortgage money to agriculture. It will attempt to recognize the

inter-relationship with the existing stock of mortgage debt. In addition, it will recognize that mortgage money is used both to finance new capital and to transfer the ownership of real estate.

The amount of credit demanded will be inversely related to the price of credit, or the rate of interest. If one takes a sufficiently broad conception of the production function to include credit as an input, the negative slope to the demand relation can be argued from the declining marginal productivity of an input.

The "price" of farm mortgage credit manifests itself in more than one dimension, however. Besides the rate of interest, factors such as the term of the loan and size of downpayment are also subject to market determination. In this study the rate of interest is the only price factor considered. To the extent that the various price factors move together, the rate of interest may serve as a proxy for all of them. The analysis will, however, probably over-state the true price effect of the interest rate on the demand for credit.

Given a demand for funds to be used either for new capital formation or for the transfer of ownership of real estate, the demand for credit will be inversely related to savings in agriculture. Other things being equal, the more savings available in agriculture, or the more internal funds available, the less need there will be for the use of credit, or external funds.

The variable used for this economic factor is a synthesized concept of internal funds that approximates a measure of realized farm income. It is a measure of the funds available for all uses within agriculture, including consumption and saving. To the extent that the marginal propensity to consume out of these funds is constant, the income concept will be representative of the savings available within agriculture. Tostlebe has

indicated that, with two exceptions, the rate of gross saving within agriculture has been a stable fraction of farm income over time.^{5/}

Theory of the firm considerations suggest three other variables to include in the demand relation. These variables are each important when considering the demand for credit as derived from the demand for capital.

(1) The real price of farm products is a shifter of the demand for inputs used in agriculture. To the extent that mortgage credit is used to finance long-term investments, some concept of expected prices is probably relevant.

(2) The theory suggests that the prices of other factors of production be included. In this study the prices of factors used in production, excluding labor, are introduced into the expected prices variable as a deflator. The wage rate is introduced as a separate variable because of its importance in the capital-labor substitution process. (3). Technology may be a shifter of the demand for an input.

To the extent that long-term credit is used to finance the transfer of real estate, the demand for credit would be positively related to the number of farm transfers. The rate of voluntary farm transfers was introduced as a possible shifter.

Some new loans are for refinancing part of the existing stock of mortgage debt. The volume is related to the existing stock of debt in the same sense that the replacement demand for automobiles is related to the existing stock of automobiles. For this reason, the stock of debt at the beginning of the year is introduced into the equation.

^{5/} More precisely, "There is considerable uniformity in the percentage that gross savings were of farm income net of all expenses of production except depreciation of buildings and machinery." Tostlebe, p. 145.

Statistical Results

The estimating procedure was the limited information, simultaneous equations technique. The equations are presented with the gross flow of farm mortgage credit as the dependent variable. The supply equations used to identify the demand relation will not be reported here. The variables treated as exogenous in the supply equations included the rate of return on alternative investments (the yield on preferred stocks), national saving, the rate of change of money stock, and collateral and expectation variables.

Three equations from the various models fitted are presented in table 2. The relations were estimated linearly with data from the period 1921 to 1959. Variables were deflated whenever possible to reduce multicollinearity. Adjustment mechanisms were built into the model both by the use of the stock of debt and the lagged quantity of credit, the latter on distributed lag considerations.^{6/} Neither of these is very successful.

Model 1 is an experiment with the lagged quantity, including other variables suggested above. The coefficient for farm transfers has the wrong sign, though it is not significantly different from zero. The coefficient for expected prices is not significant at usually accepted levels. The coefficients of all other variables have the correct sign and are significant at the 5-per cent level or better. Although the coefficient for the

^{6/} Introduction of the lagged dependent variable also provides a very crude test of the reliability of the over-all results. If the apparent relationship between a set of variables was due entirely to the presence of trend in each of them, or more generally to high autocorrelation in each of them, the regression coefficient of the lagged dependent variable would tend to be nearly one, and its presence in the regression would tend to make the other regression coefficients (and partial correlations) zero. Significance of other variables in the presence of the lagged variable lends them to greater credibility.

lagged variable is significantly different from zero, it does not meet the true test of the lag mechanism of being significantly different from one.^{7/}

In model 2 the expected prices and farm transfer variables are omitted and the stock of debt is introduced as an alternative to the lagged quantity. The wrong sign is obtained for both the interest rate and debt variables, and both are significantly different from zero. Introducing the stock of debt gives unsatisfactory results.

In model 3 the expected prices and farm transfer variables are omitted, but the lagged quantity is retained. The results are comparable to those of model one. The coefficient for the lagged variable declines somewhat, though it is still not significantly different from one. This model is the one used for evaluating elasticities and drawing implications.^{8/}

Statistical Evaluation

A number of inter-related statistical problems give cause for concern in evaluating the empirical results. In the first place, the time period used in fitting the model is rather long. To argue that structure has not changed during this period is at best debatable.^{9/} However, when the time period is divided into shorter segments to test for a change in structure,

^{7/} The von Neumann test does not reject the null hypothesis of no serial correlation in the calculated residuals at the 5-per cent level.

^{8/} This model is chosen despite the lower coefficient of determination than for model 1. In structural work interest centers on the significance of the individual coefficients, rather than the proportion of variation in the dependent variable that is explained. The standard error for the coefficient of expected prices is much larger than the estimated coefficient of the variable and the coefficient for farm transfers has the "wrong" sign. For these reasons they were both omitted in model 3. The higher R^2 of model 1 may be spurious, in part due to the problem of multicollinearity with the increased number of variables.

^{9/} The importance of attitudes and expectations in the credit market make it especially subject to structural changes. In addition, institutional changes such as the shift from 5-year end payments to amortized loans in the 1920's can be interpreted as changes in structure.

the equations do not meet the statistical tests for identification. This is in part related to the sluggishness of the mortgage rate of interest. Long periods of time are necessary to obtain sufficient movement in the interest rate.

The resolution of the conflicting problems of identification and structural change involves fitting the model to the entire period in order to obtain identification, but at the same time recognizing that some structural change may have taken place. Foote has pointed out in a somewhat different context that compromises of this sort are often necessary when doing empirical work.^{10/} Or, to put it realistically, the econometrician is dependent on the economy to perform his experiments. If it doesn't perform the correct experiment, he has to accept the one performed and attempt to infer as much as possible from it.

A final problem in evaluating the results is related to the identification problem. The coefficients obtained in the demand equation were rather sensitive to changes in the instrumental set included in the supply equation. The empirical evidence suggests that both the supply curve and the demand curve were subject to considerable shifts in the period of analysis. This makes the identification problem particularly acute.

Implications

The elasticities implied by model three are presented in table 3, together with estimates of the average annual percentage fluctuations in the independent variables. Only short-run elasticities are presented, despite the presence of the lagged quantity variable, since the statistical results

^{10/} Foote, R. J., Analytical Tools for Studying Demand and Price Structure, Agricultural Handbook No. 146, U.S. Dept. Agri., AMS, Washington, D.C.

Table 2. Demand Equations for Long-Term Farm Credit; Dependent Variable: Volume of Farm Mortgage Loans Closed During the Year.

Model	Interest rate Y_2	Internal funds X_1	Expected prices X_2	Tech- nology X_3	Wage rate X_4	Mortgage debt X_5	Farm transfers X_6	Lagged quantity X_7	Constant	R^2
1	-1.16 (0.62)	-1.75 (0.87)	0.08 (1.59)	-3.48 (1.39)	0.882 (0.340)		-0.20 (0.17)	0.908 (0.271)	1.09	.822
2	1.27 (0.27)	-1.63 (0.58)		-1.60 (0.79)	0.299 (0.221)	-1.79 (0.49)			0.07	.775
3	-0.903 (0.503)	-1.99 (0.76)		-3.36 (1.16)	0.907 (0.295)			0.856 (0.234)	0.91	.656

Identification of variables:

Y_2 = the rate of interest on farm mortgage loans closed.

X_1 = internal funds, consisting of net farm income, including government transfer payments; nonfarm income of farm-operator families; and net changes in the stock of liquid assets.

X_2 = expected farm prices, defined as prices received deflated by prices paid for items used in production, with weights declining geometrically. Taken from Friedman, M., A Theory of the Consumption Function, Princeton University Press, 1957.

X_3 = index of technology, an unpublished revision of the index published in graphic form in Stout, T. T., and V. W. Ruttan, "Regional Patterns of Technological Change in American Agriculture," Journal of Farm Economics, XL (May 1958), pp. 196-207.

X_4 = the farm wage rate, as measured by an index of the composite wage rate deflated by the consumer price index.

X_5 = the stock of farm mortgage debt at beginning of year.

X_6 = the number of farm transfers per 10,000 farms.

X_7 = the volume of farm mortgage credit, Y_1 lagged one year.

indicates a coefficient of adjustment that is not significantly different from zero.

Table 3. Implied Short-run Demand Elasticities at the Means and Average Annual Fluctuations of the Independent Variables.

Variable	Elasticity (at means)	Average annual fluctuation per cent
Interest rate	-2.29	2.2
Internal funds	-1.37	7.5
Technology	-1.96	5.4
Farm wage rate	1.49	5.9

Source: Model 3, Table 2.

These results indicate that the demand for long-term farm credit is interest elastic, contrary to beliefs held by some economists. At the means, a 5-per cent decrease in the rate of interest, say, from 5.00 to 4.75 per cent, would be associated with an 11-per cent increase in the quantity of credit demanded, other things remaining constant. Average annual fluctuations in the farm mortgage rate of interest have been small, although for certain isolated years the change was substantial.

In interpreting the elasticity of demand with respect to the rate of interest, the definition of the quantity variable must be kept in mind. It is the gross flow of farm mortgage loans closed, including loans to refinance existing debt. During periods when interest rates were lower than they had been previously, some farmers may have refinanced at the new lower rates. This would tend to increase the volume of farm mortgage loans closed during the period while not changing the stock of outstanding debt. The result is that the elasticity implied from having used the gross flow as a measure of the volume of credit could be expected to be larger than an elasticity obtained from having used the net flow, or the first difference of the stock of debt.

Internal funds has an elasticity greater than one, and is the most volatile of the demand snifters in the short-run. This suggests that fluctuations in internal funds are one of the main forces causing fluctuations in the quantity of farm mortgage credit demanded. That the elasticity is greater than one is probably related to the fact that measured income has a large transitory component, out of which a comparatively large fraction is saved or used for asset accumulation. This elasticity is probably underestimated since the income variable used is probably also picking up the effect of real farm prices, which would be positively related to the quantity of credit demanded.

Demand is also elastic with respect to the farm wage rate, and it is related positively. This suggests that capital (with an attendant derived demand for credit) tends to be substituted readily for labor with rises in the wage rate. Fluctuations in the real farm wage rate have been considerable, with sizeable decreases during the depression and increases during the war.

Changes in technology have apparently been a contributing factor to change in the quantity of credit. The relative substitution effects in consumption and in production are such that increases in technology lead to decreases in the aggregate demand for credit, other things being equal.

Conclusions

A number of economists, among them Tolley^{11/} and Hathaway,^{12/} have stressed the importance of improved knowledge in the credit markets. This becomes particularly important with the prediction by many that agriculture

^{11/} Tolley, G. S., "Needed Research on Capital and Credit", Capital and Credit Needs for a Changing Agriculture, edited by E. L. Baum, G. H. Diesslin, and E. O. Heady, Iowa State University Press, 1961.

^{12/} Hathaway, D. M., "Trends in Credit and Capital". (See ibid pp. 81-96.)

in the decades ahead will be increasingly reliant on external sources of credit. Information on the structural relationships can be useful to policy makers attempting to improve existing financial institutions.

The results presented in this paper are by no means the final answer in understanding the demand for farm mortgage credit. Much remains to be done in this complex but important part of the economy.

Appendix

Table 1. Input Data For Estimating the Demand Relationship for Farm Mortgage Credit.

Year	Volume of credit ^{a/} mil. \$	Interest rate %	Internal funds ^{a/} bil. \$	Expected prices index	Tech- nology index	Wage rate ^{a/} index	Stock of debt ^{a/} bil. \$	Voluntary farm transfers rate
1920	3,615							
1921	4,067	6.95	10.7	109	85.3	246	16.12	244
1922	3,990	6.07	10.1	105	87.0	245	17.04	261
1923	3,813	6.33	10.8	104	90.3	271	16.49	255
1924	3,249	6.34	11.9	104	90.5	284	16.72	296
1925	3,240	6.29	13.0	103	99.8	272	14.73	283
1926	3,128	6.26	13.3	105	98.4	285	14.94	263
1927	2,864	6.22	13.9	104	102.0	298	15.58	235
1928	2,647	6.23	13.7	102	99.4	294	15.51	237
1929	2,363	6.30	15.3	101	102.0	302	15.76	190
1930	2,432	6.36	13.9	101	95.8	312	17.17	162
1931	2,531	6.38	11.7	98	104.3	281	19.83	168
1932	2,146	6.38	8.8	91	98.1	238	21.60	178
1933	1,923	5.84	9.4	83	102.7	203	19.78	194
1934	3,738	5.33	9.8	78	94.9	205	15.78	248
1935	2,042	5.43	10.6	78	118.4	212	14.59	315
1936	1,528	5.15	12.2	82	100.4	225	14.14	305
1937	1,351	5.11	12.3	85	115.2	237	12.75	299
1938	1,415	5.08	11.8	87	118.6	252	13.61	303
1939	1,455	5.06	12.3	85	124.0	257	13.53	341
1940	1,512	4.99	12.0	83	123.0	256	12.89	417
1941	1,468	4.94	13.9	82	132.9	282	11.43	458
1942	1,188	4.90	16.5	87	146.2	324	9.93	560
1943	1,367	4.83	19.5	94	139.3	409	8.89	515
1944	1,436	4.74	19.0	102	136.9	485	7.93	573
1945	1,533	4.69	18.8	106	143.5	532	7.18	576
1946	1,888	4.52	20.8	110	150.0	507	6.05	489
1947	1,494	4.48	21.0	115	138.3	440	5.03	409
1948	1,367	4.56	18.4	118	149.5	426	4.85	370
1949	1,420	4.73	18.6	117	137.5	433	5.33	394
1950	1,606	4.73	17.6	114	146.5	419	5.41	374
1951	1,542	4.74	17.7	111	142.7	419	5.33	342
1952	1,593	4.92	18.2	111	143.6	455	5.93	299
1953	1,684	4.97	17.8	109	148.5	470	6.60	319
1954	1,709	5.00	16.0	106	152.5	461	7.05	319
1955	2,170	4.87	16.2	104	155.0	469	7.49	324
1956	2,089	4.92	17.0	100	156.6	474	7.93	314
1957	1,917	5.19	15.1	97	159.7	476	8.43	311
1958	2,041	5.36	16.3	95	172.1	483	8.82	312
1959	2,355	5.41	16.2	95	169.0	514	9.42	307

^{a/} Deflated by the wholesale Price Index, 1947-49 = 100.

Source: see next page.

Source of data, appendix Table 1.

Volume of Credit: U. S. Department of Agriculture, Agricultural Finance Review, Vol. 22, Sept. 1960, p. 120.

Interest Rate on Farm Mortgage Loans Closed: 1921 to 1935, Bureau of Agricultural Economics, Average Rates of Interest Charged on Farm-Mortgage Recordings of Selected Lender Groups, 60 pp., Washington, D.C., (processed); Odd-numbered years, 1941 and subsequently, USDA, Major Statistical Series, Agr. Handbook No. 118, Vol. 6, p. 25; Estimates for the interim years were made from primary data obtained from insurance companies. See L. F. Hesser, unpublished Ph.D. thesis, op. cit., for details of these estimates.

Internal Funds: (1) Net Farm Income: USDA, Agr. Handbook No. 118, Vol. 3, and subsequent issues of The Farm Income Situation. (2) Financial assets: 1921 to 1939, R. W. Goldsmith, Saving in the United States, Vol. 1, p. 829; 1940 to 1959, unpublished data from Farm Economics Division, ERS, USDA. (3) Nonfarm Income of Farm People: 1934 to 1959, Agr. Handbook No. 118, Vol. 3, p. 45, and subsequent issues of Farm Income; 1921 to 1933, estimated by multiple linear regression. Internal funds was synthesized by adding (1) and (3) plus changes in (2). See above-mentioned thesis for details.

Expected Prices: A weighted average of "real" farm prices (index of prices received for all farm products, divided by the index of prices paid for items used in production). The weighting pattern used was a modification of one developed by M. Friedman, in A Study of the Consumption Function, to estimate "expected" income.

Technology: The index used was an unpublished revision of Ruttan's index published in graphic form, T.T. Stout and V. W. Ruttan, "Regional Patterns of Technological Change in American Agriculture," JFE, May 1958.

Wage Rate: This is an index of the "composite farm wage rate," Agr. Handbook No. 118, Vol. 7, p. 13, and subsequent issues of Farm Employment.

Stock of Farm Mortgage Debt: American Bankers' Association, 1960 Agricultural Credit and Related Data, p. 31.

Voluntary Farm Transfers: The number of voluntary farm transfers per 10,000 farms, unpublished data furnished by the Farm Economics Division, ERS, USDA.

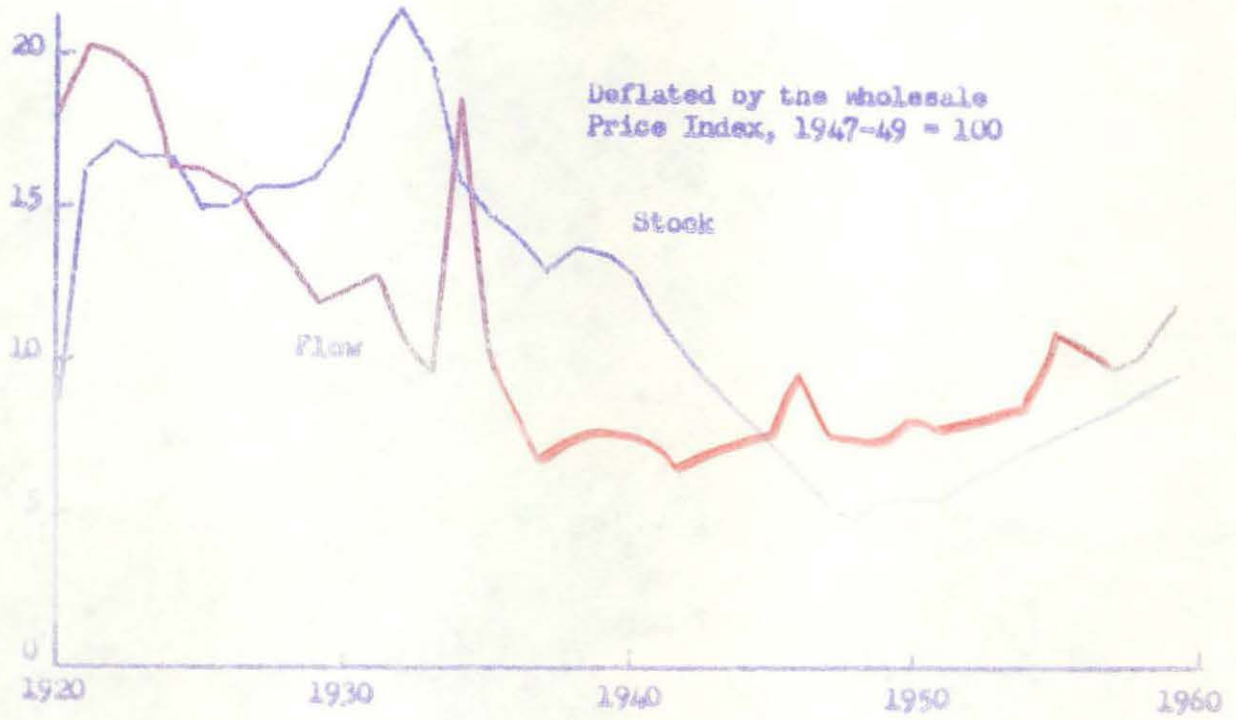


Figure 1. The Real Value of Outstanding Farm Real Estate Debt on January 1, and Annual Gross Flow of Farm Real Estate Credit, U. S., 1920 to 1959.

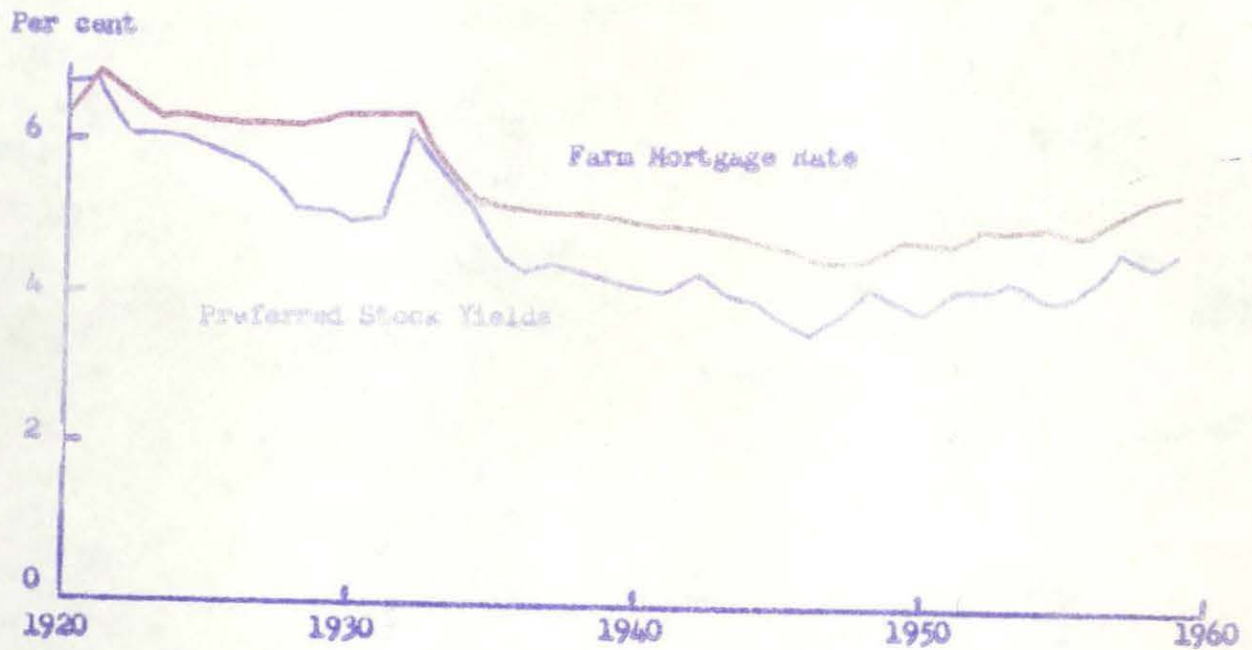


Figure 2. Average Rate of Interest on Currently Negotiated Farm Mortgage Loans and Yields on Preferred Stocks, U. S., 1920 to 1959.