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SUBSIDIZED CREDIT AND INVESTMENT IN AGRICULTURE: THE SPECIAL CASE OF FARM REAL ESTATE

by

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Farm Values

The purpose of this paper is to provide initial estimates of the impact that government farm credit policies have on the market for farm land. Three specific questions are addressed. How have government farm credit programs influenced (1) farm land prices, (2) farm indebtedness and the (3) the fraction of farm land owned by farmers? The paper is divided into three major sections. First, a theoretical model of the farm land market capable of capturing the effects of interest rate subsidies is developed. The second section presents the results of estimating the model and simulating it under different subsidy regimes.[1] The final section summarizes the findings of this paper and raises some questions for further research.

Interest Rates and Farm Real Estate Values

There have been many studies of the determinants of farm real estate values in recent years (Barry, Brown and Brown, Boehlje and Griffin, Melichar). Central to all these studies is the capital asset pricing (CAP) model which allows a future stream of income to be translated into a current value. Simply stated, the CAP model requires the price of an asset to equal the discounted value of all expected future cash flows. Few disagree that the CAP model forms an appropriate starting point for explaining the value of assets such as farm real estate. Past debates, disagreements and advancements of knowledge have come about through proposals specifying how the expectations of future net cash flows are formed and the appropriate discount factor to use.

Missing from previous studies has been consideration of the fact that there is more than one group competing for farm land in the United States. Farmers use land as an input to production. In addition, land enters the utility functions of nonfarmers and nonoperator landlords, either for residential use or as an investment alternative. Since these groups have different sources of income, use land in different ways and might have different portfolio balancing preferences, their demands for land can shift over time in divergent ways. Moreover, one of the principal justifications for farm credit programs has been to preserve an agricultural structure domintated by owner operators and to avoid the perceived costs of significant separation of land ownership and management in agricultural production. It is important, therefore, in identifying the impacts of any one of the many factors influencing farm land values, to account separately for these different demands.

Farm business demand for land

Assuming the objective of farmers is to maximize the net present value of their net worth and, for simplicity, letting output be generated by a Cobb Douglas production function, the optimal quantity of a durable input such as land can be expressed in the following form (Penson, Romain and Hughes):

$$(1) \quad K_{fl,FOF}^{*} = bRE_{FOF}/(P_{fl}C)$$

where $K_{fl,FOF}^{*}$ is the optimal quantity of land owned by farmers, b is the partial elasticity of production for land, RE_{FOF} is expected gross revenues from farm production, P_{fl} is the price of farm land and C is the nonprice implicit rental cost of land--an adjusted marginal factor cost.

In this model, interest rates on debt enter into the demand for land through the rental cost (C). C is a complex function (Coen; Penson, Romain Hughes; and Jerimias) where the cost of using a capital input is related to the price of the item, the required return on equity, the item's physical depreciation, income taxes, property taxes, debt financing decisions and the interest rate on debt. The nonprice implicit rental cost reflects all of these factors except the price of the item. Since land does not depreciate and is not subject to investment tax credit, its implicit rental cost is significantly simplified and can be defined as follows:

$$(2) \quad C \equiv q \frac{[1 - a + (1 - t_{pr})aU + aV]}{(a - t_{pr})}$$

where q is the required return on equity, a is the fraction of land purchased using debt financing, t_{pr} is the tax rate on profits, U is the present value of the real interest payments on a loan of one dollar and V is the present value of the real principal payments on a one dollar loan. Both U and V are discounted using the investor's required return on equity. The discounted present value of the loan, therefore, need not be equal to its starting principal balance.

Nonoperator landlord demand for farm land

Nonoperator landlords' demand for land is assumed to be made on the basis of their desires to balance portfolios of assets and liabilities (Tobin, Penson). This means that their demand function can

be expressed as follows:

(3) $K^d_{fl,NOL} = f(r_{land}, SOPA_{NOL}, SFA_{NOL}, SDT_{NOL}, Y_{NOL})$

where, $K^d_{fl,NOL}$ stands for the amount of farm land demanded, r_{land} is the total return on land ownership, $SOPA_{NOL}$ is a vector of other physical assets owned, SFA_{NOL} is a vector of the stocks of financial assets owned and SDT_{NOL} is a vector of the stocks of debt owed by nonoperator landlords, and Y_{NOL} represents their current income.[2]

Farm operator families, in addition to wanting land for production purposes, may also desire land as part of their portfolios. The demand for land by farmers is, therefore, a combination of equations 1 and 3, or:

(4) $K^d_{fl,FOF} = f(RE_{FOF}/(P_{fl}C), SOPA_{FOF}, SFA_{FOF}, SDT_{FOF})$

Government credit programs for farmers have two influences on how much land farmers desire to own. The direct influence is to decrease the implicit rental cost of capital by making debt financing of land purchases less expensive. The indirect effect comes through farmers' portfolio balancing actions. With debt less expensive, farmers are likely to increase their indebtedness. The portfolio balancing effect of more debt may be to either magnify or reduce the direct impact of government credit programs, and can only be assessed by empirically determining whether debt and land are net compliments or substitutes in the minds of farmers.

Farmers' demands for other assets and debt are, therefore, also required to capture the multiple simultaneous influences of subsidizing interest rates to the sector. These demands can be expressed as:

(5) $SFA_{FOF} = f(r_{fa}, S_{fl,FOF}, SOPA_{FOF}, SDT_{FOF}, RE_{FOF})$

(6) $SOPA_{FOF} = f(SFA_{FOF}, S_{fl,FOF}, SDT_{FOF}, RE_{FOF})$

and,

(7) $SDT_{FOF} = f(r_{debt}, SFA_{FOF}, S_{fl,FOF}, SOPA_{FOF}, RE_{FOF})$

where variables not previously defined are S_{fl}, which represents the stock of farm land given by multi-

plying price times quantity held, r_{fa} which is the return on financial assets, and r_{debt} which represents the interest rate on debt.

Depending on the nature of the government credit program, the definition of what nonoperator landlords view as the returns to land ownership and their sensitivity to such returns, government farm credit programs can also influence nonoperator landlords' demand for land. While this paper focuses on government farm credit programs that provide subsidies only to farm operators, such programs can increase nonoperator landlords' demand for land. If nonoperators view real price increases in land values as part of their return from land ownership, subsidized credit programs for farmers which initiate land price increases will change the relative return in nonoperator landlords' portfolios and increase their demand for land.

The net impact of these programs on the price of land and the proportion of farms in tenancy depends on the size of the responses of farmers and nonfarmers. If both demands increase, land prices will certainly rise. If farmers' demands shift more than nonoperator landlords' demands, rentals will decline. If, however, nonoperator landlords' demands respond more strongly than farmers', rentals will increase.

The supply of land

As mentioned earlier, the total supply of farm land is not fixed. Price increases for land can lead to land improvements while price declines can lead to removal of farm land for other uses. It can be expected, therefore, that the supply of farm land in the U.S. has a small positive slope.

To complete the specification of the farm land model used in this paper, a supply function and market clearing equation are needed. The supply of farm land is given by:

$$(8) \quad K_{fl}^{s} = f(P_{fl}, P_{lab}, P_{build})$$

where K_{fl}^{s} is the supply of farm land, P_{fl} is the price of farm land, P_{lab} is the wage rate for labor and P_{build} is the price of buildings. P_{lab} and P_{build} reflect the costs of transforming farm land to other uses or improving the quality of the land.

The market clearing equation is:

(9) $K^s_{fl} = K^d_{fl,FOF} + K^d_{fl,NOL}$

The farm land market is thus expressed in seven equations--numbers 3, 4, 5, 6, 7, 8 and 9 above.

Empirical Analysis of the Farm Land Market

This section presents estimates of the equations developed in the first section and then uses simulations of these equations as a starting point for further debate on the difficult questions pertaining to the impacts of government farm credit programs.

Estimated equations

Since farmers purchase most of the farm land sold in the U.S. each year, it seems reasonable that the principal factors used in explaining changes in the price of farm land be those describing the economic conditions of farmers. Equation 1 was, therefore, solved for the price of farm land. In specifying equation 4, price thus became a function of quantity of farm land owned by farmers, returns to farming, the nonprice components of the implicit rental cost of land, the stocks of other assets and debts of farmers. The market clearing equation, equation 9, was eliminated by solving for the quantity of farm land owned by farm operators and then substituting the result into equation 4.

The remaining six equations were estimated over the 1956-80 period using the two stage least squares estimator. Initial estimates suggested substantial autocorrelation, so first differences were used which significantly reduced the problem. One unique adaptation was made in order to continue to include the partial adjustment hypothesis. A simple first difference of all variables, including the dependent variable, would imply a coefficient of plus one on the lagged dependent variable. If, however, a market does not fully adjust within one year, a partial adjustment hypothesis can be included by using the level as the dependent variable and including the lagged dependent variable as an explanatory factor. Of the six estimated equations, only two--the stock of other physical assets owned by farm operator families and the quantity of farm land owned by nonoperator landlords--had coefficients on the lagged dependent variable significantly different from one.

The immediate direct impact on the price of farm land of decreasing farm interest rates is very small. A ten-percent decline in interest rates decreases C by 0.7 percent, which increases $RE_{FOF}/K_{fl}C$

by about the same percentage. This effect is magnified by the differencing process to a 2.6 percent increase, but yields only a 0.02 percent increase in the price of farm land. Decreasing farm interest rates to 90 percent of what they would otherwise be has only a slightly greater effect on farm debt and the price of farm land. If real interest rates are at five percent and by experiment decline to 4.5 percent, debt would increase by $.06 billion in the first year. When multiplied by the sensitivity of farm land prices to changes in farm debt, this translates into an increase of 0.15 in the constant dollar index of farm land prices. Since the index was about 2.0 in 1980, the first year's portfolio balance contribution to the change in price is 0.08 percent. Over time, however, the impact is likely to grow since debt is positively related to the value of farm land, and the value of farm land rises with growth in debt.

Simulation results

To assess the importance of government credit programs in agriculture, a measure of the size of the subsidy is needed. The USDA has recently developed some initial estimates of the magnitude of these subsidies (Meekhof). These measures were developed by comparing interest rates charged and the maturities of loans made by the Farmers Home Administration (FmHA) and the Farm Credit System (FCS) to similar loans made by other commercial lenders.[3] While the exact numbers are not currently available for distribution, the subsidies average about ten percent of farm interest expenses. Thus, adding ten percent to nominal interest rates charged farmers will likely generate results that are of the proper order of magnitude. Since nominal interest rates ran well above five percent and less and fifteen percent between 1976 and 1980, this translates into about a one-percentage point subsidy on farm interest rates.

A baseline simulation of the model was developed by solving the equations over the 1976 to 1980 period using actual values of the exogenous variables. Longer run equilibriums were then determined by solving the equations for another ten years holding all exogenous factors constant at their 1980 levels. Table 1 presents the results for the baseline simulation and the two experiments run to bracket the minimum and maximum responses to government credit programs. The one-percentage point subsidy experiment represents a minimum significant response since a zero subsidy obviously would have no impact. It seemed reasonable, given the USDA's estimates, to assume that interest subsidies were no

greater than five percentage points. Thus, the second experiment represents an upper limit on the effects of government farm credit programs.

The results of the simulations suggest government credit has not had a large impact on farm real estate markets. As expected, first year impacts are very small. Longer run impacts on farm land prices are also small in percentage terms. A one-percentage point subsidy on farm debt yields a long run increase in farm land prices of slightly over two percent. A five-percentage point subsidy generates 6.5 percent higher farm land prices. In dollar terms; however, these changes are in the tens of billions. Since farm real estate is valued at about $800 billion, a two percent increase would equal $16 billion, and a 6.5 percent increase would equal $52 billion in wealth transferred to farmers through government farm credit programs.

The influence of farm credit subsidies on farm debt was projected to be stronger than the influence on farm land prices. Short run impacts were small. The removal of a one-percentage point subsidy decreased farm debt by only 0.5 percent in the first year. The first year impact of removing a five-percentage point subsidy was to reduce farm debt by 2.3 percent. Over the long run, the impacts were more significant, with the removal of the one- and five-percentage point subsidies decreasing farm debt by 1.5 percent and 4.7 percent, respectively.

The impact of government farm credit programs on tenancy is estimated to be extremely small. Over a short to intermediate number of years, government subsidy programs for farmers increase farmers' ownership of land. Over a longer number of years, however, larger capital gains available for investing in farm land increase nonoperators' demand for land by as much as, if not more than, operators' demands are shifted by the subsidy.

The major impacts of farm credit programs were on farmers' ownership of financial assets and their indebtedness. Without government credit subsidies from 1976 to 1980, farmers would have held fewer financial assets and owed less debt than they did with the programs. Whether this is good or bad is an interesting topic for debate. If farmers had been less indebted going into the current farm recession, more firms would have survived and there would have been fewer adjustment problems. If they had held fewer financial assets, however, the opposite would be true.

Concluding Comments

In general, government farm credit subsidies have likely increased farm real estate values, farmers' holdings of financial assets and farm debt. Such programs seem to have little long term impact on the total amount of farm real estate or the distribution of ownership between farmers and nonoperator landlords. The short run impacts of such programs are small, as might be expected given the characteristics of farm real estate markets. Over the longer run, however, government credit programs have probably increased farm sector wealth by tens of billions of dollars by increasing the price of farm land.

It is highly unlikely, however, that the rapid rise in farm real estate values during the 1970's should be principally attributed to government intervention in farm credit markets. The 1970's increase in farm real estate values of hundreds of billions of dollars was more likely caused by other factors, such as the rapid increase in farm exports.

As is always the case, several interesting questions for further research have grown out of this study. What are the impacts of government credit programs on the ability of young farmers to purchase the land they need to be owner operators? Is it possible to capture the direct impacts of government farm credit programs on nonoperators' demand for farm land with a larger effort? And, finally, since farmers compete for the use of land with contractors wanting to build houses, what are the impacts of housing subsidies on farmers? Could it be that subsidizing farm credit benefits society by offsetting some of the misallocations of resources caused by subsidies to homeowners?

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Footnotes

1. For a more complete description of these results, see Hughes, Penson and Bednarz.
2. There seems to be an implied preference in current econometric work to include rates of return or prices rather than quantities to represent complements and substitutes for the good being studied. While there is no definitive answer to the question of which is better, one observation is worth note. Whenever stock variables are useful in explaining the demand or supply of a good, it would seem appropriate to use a quantity measure rather than a price or interest rate. The quantities reflect the influences of all of the changes in prices that have occurred over the life of the asset or debt. The substitution of prices or interest rates would require a long distributed lag series to represent the same information. Moreover, it is likely that the structure of the distributed lag would be found to be unstable given the nonlinearities captured in the continuous definitional updating of many stock variables.
3. These estimates have offsetting errors. Commercial lenders probably would charge a substantial risk premium to FmHA borrowers that is not reflected in the procedure. Offsetting this is the fact that much of the difference between FCS rates and other rates is due to their average cost pricing. Thus, much of the perceived difference in rates on new loans by the FCS is paid for by existing borrowers of the system and is not a government subsidy.

References

Barry, Peter J. "Capital Asset Pricing and Farm Real Estate." *Amer. J. Agr. Econ.* 62(1980):549-53.

Boehlje, Michael, and Steven Griffin. "Financial Impacts of Government Support Price Programs." *Amer. J. Agr. Econ.* 61(1979):285-96.

Brown, Keith C., and Deborah J. Brown. "Heterogenous Expectations and Farmland Prices." *Amer. J. Agr. Econ.* 66(1984):164-69.

Coen, Robert M. "Investment Behavior, the Measurement of Depreciation and Tax Policy." *Amer. Econ. Rev.* 65(1975):59-74.

Hughes, Dean W., John B. Penson, Jr. and Curtis R. Bednarz. "Subsidized Credit and the Farm Real Estate Market", forthcoming Departmental Information Report, 1984.

Jeremias, Ronald A. "Investment in Farm Tractors: Comment." Unpublished manuscript, USDA, ERS, NED, Dec. 1981.

Meekhof, Ronald. "Federal Credit Programs for Agriculture." Manuscript in progress to be included in a collection of policy papers published by the Steering Committee for Agriculture of the Center for National Policy, Summer 1984.

Melichar, Emanuel. "Capital Gains versus Current Income in the Farming Sector." *Amer. J. Agr. Econ. 61(1979):1086-92.*

Penson, John B., Jr. "Demand for Financial Assets in the Farm Sector: A Portfolio Balancing Approach." *Amer. J. Agr. Econ.* 54(1972):163-74.

_____, Robert F. J. Romain, and Dean W. Hughes. "Net Investment in Farm Tractors: An Econometric Analysis." *Amer. J. Agr. Econ.* 63(1981):629-35.

Tobin, J. "Liquidity Preference as Behavior Towards Risk." *Rev. Econ. Stud.* 25(1958):65-86.

Table 1: Simulation of the Farm Real Estate Market With Different Interest Subsidies

	Baseline			Removal of One Percentage Point Subsidy			Removal of Five Percentage Point Subsidy		
	1976	1980	1980 Plus 10 Years	1976	1980	1980 Plus 10 Years	1976	1980	1980 Plus 10 Years
	----------Levels----------			---% Change from Base----			----% Change from Base----		
Price of farm land	1.62	2.16	3.25	-0.3	-2.1	-2.2	-1.7	-5.6	-6.5
Quantity of farm land:									
Farmers	104.4	103.7	99.6	0.0	0.7	-0.1	-0.1	+1.7	-0.3
Others	48.2	46.6	45.5	0.0	-1.5	0.1	0.1	-4.1	0.4
Total	152.5	150.3	145.1	0.0	0.0	-0.1	0.0	-0.1	-0.1
Farmers' portfolio:									
Financial assets	8.0	6.1	2.8	-0.3	-1.3	-6.2	-1.7	-4.0	-18.5
Other physical assets	158.6	181.1	210.1	0.1	0.1	0.1	0.2	0.3	0.3
Debt	58.6	72.7	103.9	-0.5	-1.1	-1.5	-2.3	-3.3	-4.7