The Financial Health of Agricultural Lenders

Working Paper

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Recent turmoil in financial markets heightened awareness regarding the importance of credit availability. Many of the nation's largest financial institutions have experienced severe financial stress and credit availability has decreased. With decreased access to credit, U.S. consumers have reduced consumption, business investment has slowed, and the economy slid into a severe recession. The problem is self-reinforcing as the recession has further strained credit availability making the general economic slowdown deeper. Many observers have wondered how these conditions will influence the availability of credit to the agricultural sector.

Like the broader economy, agricultural markets have seen considerable uncertainty. As in the late 1970s and early 1980s, a weak dollar and government policies (e.g. ethanol mandates) have contributed to a run-up in commodity prices. Farm land prices have reached historic highs. A global recession impacting agricultural exports, recent sharp declines in commodity prices, the potential for declining land values, and other factors have left some wondering if another 1980s-type agriculture bust is eminent.

The agricultural sector has experience with a financial crisis. Beginning in the late 1970s, agricultural incomes and asset values began to increase rapidly. During the 1980s a farmland asset price bubble burst, and many farmers and agricultural lenders experienced severe financial stress. The result was more than 200,000 producers becoming financially insolvent and declaring bankruptcy (for a more complete review of the 1980s agricultural credit crisis see Peoples, et al 1992).

The financial stress of farm borrowers spread to agricultural lenders. In 1985 and 1986 agricultural banks charged off $2.5 billion in bad loan losses (Peoples, et al 1992). From 1985 to 1987 more than 50 agricultural banks failed each year. In the 1985 Farm Bill the federal government implemented provisions that allowed agricultural banks to shift debt to the Farmers Home Administration (FmHA). FCS charged off nearly the same amount as agricultural banks, $2.4 billion in bad loan losses. The charge offs resulted in the FCS undergoing a major internal restructuring that ultimately led to mergers among many farm credit associations. In addition, the FCS Financial Assistance Corporation was created in 1987 to provide capital to the system in the form of bonds backed by the U.S. treasury.

Credit supplied by commercial banks and the Farm Credit System (FCS) is critical to the functioning of the agricultural production system making it important to consider the financial health of these institutions. Therefore, the paper has three primary objectives. First, the underlying financial and economic fundamentals of the agricultural production sector are examined in order to understand how these conditions will influence debt repayment and future credit supply. Second, the financial condition of agricultural banks[1] and the FCS is assessed. Third, the effect of changes in underlying asset values on the financial condition of agricultural banks and the FCS is examined.

Financial Condition of Farmers

The U.S. agricultural system is capital intensive. According to the farm sector balance sheet estimated by the Economic Research Service (2008) the current agricultural production system uses approximately $2.3 trillion of assets, 9.1 percent of which is funded by debt. The

[1] Agricultural banks are defined based on the *Agricultural Finance Databook* definition. An agricultural bank has a proportion of farm loans to total loans that is greater than the unweighted average at all banks, which is approximately 14.5 percent each year.

agricultural sector's debt is generally used to fund operating needs such as supplies and agricultural inputs, intermediate-lived capital purchases such as equipment, and the purchase of long-lived capital assets such as buildings and real estate. Presently, operating and intermediate debt accounts for 48 percent of the total credit supplied to the sector, while the rest is associated with real estate. The vast majority of the debt (82 percent in 2007) is provided by two major types of financial institutions: commercial banks and Farm Credit System associations.

Since the crisis of the 1980s, farm borrowers' debt levels, repayment capacity, and asset values have undergone significant changes. These factors are critical to the ability of agricultural borrowers to repay loans from earnings as well as the ultimate downside exposure that financial institutions have to situations where repayment is compromised. In other words, the risks that financial institutions face from loans to agriculture is dependent upon earning generation as well as the valuation of assets held as collateral. In the case of collateral this is particularly true where farmland has doubled in value of the last ten years and now accounts for 87 percent of the sector's asset base.

Leverage and Repayment

Figure 1 illustrates the farm sector's debt-to-asset ratio and debt repayment capacity utilization (DRCU) from 1977 to 2008. The debt-to-asset ratio identifies the proportion of assets that are financed with debt. The DRCU is a debt coverage ratio that considers all available farm sector income to service outstanding sector debt at a reasonable margin for capital replacement and contingencies. The DRCU is calculated in a manner consistent with the assumptions used by the Economic Research Service of the U.S. Department of Agriculture.[2]

[2] The following assumptions and calculations are taken from the Economic Research Service of the USDA and can be found at http://www.ers.usda.gov/Briefing/farmincome/glossary/def_drcu.htm. A maximum loan payment is

As the DRCU approaches one, the ability of the sector to service additional debt is greatly reduced, as illustrated in the 1980s when farm debt service requirements were high relative to earnings. In 1970, farm sector debt was $48.5 billion and by 1980, farm sector debt had more than tripled to $162.4 billion. In addition, farm incomes were declining. As farm income declined, the DRCU rose above one.

Since 1984, farmers have de-leveraged to historically low levels, as indicated by the debt-to-asset ratio and the DRCU. Although farms appear to have capacity to add additional debt and present interest rates are accommodative, farmers have not added debt as they did in the 1980s. The relatively conservative use of debt and additional borrowing capacity should benefit the farm sector during and after the 2008 financial crisis. Although the debt to asset ratio and DRCU point to a favorable financial situation in the farm sector, it is important to consider the role that farmland values play in the financial health of the sector and whether these values are consistent with the earnings generated by the sector.

Agricultural Land's Price-to-Earnings Ratio

Farmland values are perhaps one of the most widely researched topics in agricultural economics. Prior to the 1980s farm crisis, the 1979 proceedings issue of the *American Journal of Agricultural Economics* featured several articles that discussed the valuation of farmland in

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calculated by taking the farm sector's income for debt coverage (net cash income plus interest payments) divided by an assumed minimum debt coverage ratio (1.25:1)
$Maximum\ Loan\ Payment = \frac{(Farm\ Sector\ Net\ Cash\ Income + Farm\ Sector\ Interest\ Payments)}{Minimum\ Debt\ Coverage\ Ratio}$. This maximum loan payment is then multiplied by the present value of an annuity of $1 at the average non-real estate interest rate (r), taken from the Agricultural Finance Databook, for a hypothetical repayment term (n) of 7 years
$Debt\ Repayment\ Capacity = Maximum\ Loan\ Payment * \frac{1-(1+r)^{-n}}{r}$.
Finally, debt repayment capacity utilization is calculated by taking the total farm sector debt divided by the calculated debt repayment capacity as shown in $Debt\ Repayment\ Capacity\ Utilization = \frac{Total\ Farm\ Sector\ Debt}{Debt\ Repayment\ Capacity}$.

relation to the earnings of the farm sector (Melichar; Reinsel and Reinsel; Plaxico; McConnen). These articles discussed how farmland values at the time had increased relative to the earnings of the sector and the implications of these increases. Recently, Moss and Katchova conducted a review of the literature associated with farmland pricing

While a detailed analysis of farmland prices is beyond the scope of this paper, insights can be gained by simply examining farmland earnings and prices. The price-to-earnings ratio (P/E ratio) is commonly used to assess the value of capital assets. In general, higher (lower) P/E ratios indicate investors are willing to pay more (less) for an asset relative to its current earnings. Among other things, differences in P/E ratios across assets can arise due to investors' perception of the growth potential of earnings as well as the cyclicality of earnings. While one must be cautious in applying the P/E ratio, it can clearly shed light on the pricing of capital assets.[3]

A clear spike in the ratio of average agricultural land value to average net cash farm income illustrates the run-up in agricultural land values from the mid-1970s to the crash in 1980 (figure 2). Average net cash farm income is used to proxy earnings because it is the best available U.S. agricultural sector earnings variable. Featherstone and Baker (1987) found that agricultural land values during the time period had a propensity for bubbles that ultimately led to a downward correction in land values.

As one would expect, the P/E ratio for farmland has been volatile due to fluctuations in earnings and prices of farmland. The relationship between these variables is imprecise because land values are determined by the discounted value of future earnings for farmland and current

[3] In the case of agriculture, one must also be cautious when comparing net cash income to farmland values because net cash income is also a return to other unpaid factors of production such as unpaid labor and management. If the relative shares of these inputs changes over time it could confound changes in the P/E ratio. Additionally, livestock operations whose residual return may flow to specialized buildings or breeding stock could confound the ratio. Some studies at the University of Illinois found P/E ratios to be much higher than presented in this paper. In those studies, they were able to track the share of earnings being reinvested into farm land. In addition, they focused on Illinois, which may elevate their estimates relative to ours. Finally, we conducted our own 'robustness' checks on USDA/NASS cropland value to cropland cash rent data and found that an upward trend was still present.

earnings do not always reflect future expected earnings. One of the interesting characteristics of figure 2 is the apparent upward trend in the P/E ratio for farmland over the period 1960-2008. Based on a simple trend line regression, the P/E ratio has increased annually by 0.16.

The presence of any trend, even a seemingly modest increase, is surprising. The trend could be a function of several factors, including expectations over the growth in earnings that can be generated from farmland. The trend could also result from increased demand for conversion of farmland to higher value non-agricultural uses such as housing development, more favorable capital gain tax treatment, and/or tax policies such as section 1031 exchanges which allow investors to defer capital gains on real estate transactions by purchasing like-kind real estate.

Currently, the ratio of agricultural land values to net cash farm income is above the trend line. It appears that farmland valuations are relatively high given the current earnings of the farm sector, indicating that farmers expect earnings to increase in the future. Given the recent amount of volatility of the ratio, it is possible that the ratio could be due for another correction if earnings do not continue to increase. An analysis of demand factors is warranted to fully understand the trend in the P/E ratio, and the implications not only for farmers but also agricultural lenders.

Financial Condition of Agricultural Lenders

Agricultural lenders' current financial condition is largely dictated by the quality of their balance sheet, profitability, and cash flow. In general, the structure of the financial condition for agricultural lenders has improved since the 1980s farm debt crisis.

Land Values, Net Loan Charge Offs, and Bank Failures

During the 1980s farm debt crisis, net loan charge offs and agricultural bank failures increased while agricultural land values eroded (figure 3). Net loan charge offs in figure 3 are for all loans, not just agricultural loans, for agricultural banks. The reason for using all net loan charge offs is because agricultural net loan charge offs are only available back to 1985. In addition, the correlation between net loan charge offs and agricultural net loan charges is 0.98. While the FCS is not shown in figure 3, their net loan charge offs from 1985 to 2008 are comparable and show a similar pattern. In addition, the FCS's net loan charge offs during the period had a 0.97 correlation with agricultural bank net loan charge offs. Figure 3 captures how dire the financial health of all agricultural lenders was during the 1980s farm debt crisis.

Figure 3 also illustrates an interesting relationship between agricultural land values and net loan charge offs. It appears that agricultural land values are a leading indicator for net loan charge offs. As land values decline, net loan charge offs increase. As will be discussed below, a Granger causality test finds that past values of agricultural land values have a significant impact and are negatively correlated with current net loan charge off rates. This statistical result supports the assertion that many lenders during the 1980s were collateral based lenders. Thus, as agricultural land values deteriorated, so did their financial health in the form of higher net loan charge offs and bank failures.

Agricultural Lenders Financial Health

Agricultural banks and the FCS have undergone significant changes over time. Many of these changes are a product of the 1980s farm debt crisis. The regulatory environment has changed. Lenders have moved from collateral based lending to cash flow based lending. Additionally, there have been many advances in methods to assess credit risk associated with borrowers

(Gustafson, Pederson, and Gloy). Yet, uncertainty abounds in the agricultural and global economy, which poses a threat to agricultural banks and the FCS. One of the key tools that lenders use to balance the risk of loan repayment problems is the level of capital that they hold to absorb losses. The level is typically measured by the lender's capital ratio.

Agricultural banks and the FCS have increased their capital-to-asset ratios since the 1980s (figure 4). While agricultural banks capital position has increased slightly, the FCS has seen their capital position nearly double since 1990. Yet, the FCS's capital ratio has declined sharply since its peak of 0.17 in 2004 to its current level of 0.13. Arguably the largest contributing factor to the decline in capital is the substantial loan volume growth the FCS has experienced recently. In 2004, the FCS had a total of $96.4 billion loans. By the end of 2008, total loans had grown to $161.4 billion. Another factor is a very large farm credit association, Farm Credit Services of America, began paying patronage in 2004 and many other associations followed.

Similar to capital ratios, both agricultural banks and the FCS have achieved relatively high and stable rates of return on equity since the farm crisis (figure 4). Since 1992, the FCS has held a larger capital cushion than agricultural banks. One reason that the FCS has held a larger capital cushion is that congressional mandate restricts FCS lending to the agricultural sector, resulting in greater exposure to agricultural loans than agricultural banks. At the end of 2008, the FCS had $161.4 billion in loans whereas all commercial banks had $121.6 billion in agricultural loans (Board of Governors of the Federal Reserve System 2009). Although these are similar amounts, commercial banks, and to a certain extent agricultural banks, have the potential to diversify their loan portfolio across sectors and lower their relative exposure to agricultural loans.

Compared to the hardships of the 1980s, the current financial health of agricultural bankers and the FCS appears to be relatively strong. However, real agricultural land values have reached historically high levels and there is much uncertainty in the agricultural and global economy. Therefore, how and by how much would the financial health of agricultural banks and the FCS change if agricultural land values fell?

Responding to a Land Value Shock

The Granger causality test found that agricultural land values and net loan charge offs exhibited significant negative correlation. The relationship makes intuitive sense because many agricultural loans were secured by agricultural land. As farmers defaulted on loans, net loan charge offs had to rise because the underlying collateral had declined in value.

A simple vector auto-regression (VAR) model was estimated based on historical data for land values and loan charge offs to examine the impact of a shock to land values. The orthogonal impulse response function from this model provides a way to motivate a 'what if' discussion of an agricultural land value shock's impact on net loan charge offs. While this is a simplified representation of a complex dynamic system and further research is necessary to fully examine the relationship, some insights into the financial health of agricultural lenders are taken from this VAR analysis.

VAR Model and Results

Real agricultural land values and net loan charge offs at agricultural banks are related because agricultural banks will secure loans with agricultural land as collateral. Past studies have found that agricultural land values have a propensity for bubbles (Featherstone and Baker) and land

value declines are influenced by a stressed agricultural environment (Burt). Thus, the objective here is to test if there is a significant relationship between real agricultural land values and net loan charge offs. And if so, stress agricultural land values to test how net loan charge offs would react.

In order to meet this objective, an empirical model is necessary that captures the dynamic relationship between real agricultural land values and net loan charge offs. A VAR model is selected because it allows the dynamics of real agricultural land values to be affected by the stochastic process of net loan charge offs. This is accomplished by modeling each variable as being endogenous and including lags of each variable. In addition, VAR strengthens system identification and minimizes spurious dynamic relationships between the endogenous variables (Sims). Before implementing the model, an analysis of the data shows that real agricultural land values has a unit root. Thus, this data is first differenced (Δ). The two equation system to be modeled is,

(1) $\Delta RealAgLand_t = \alpha_1 + \gamma_1 t + \tau_1 t^2 + \sum_{i=1}^{n} \beta_{1i} \Delta RealAgLand_{t-i} + \sum_{i=1}^{n} \mu_{1i} ChargeOff_{t-i} + \varepsilon_{1t}$,

(2) $ChargeOff_t = \alpha_2 + \gamma_2 t + \tau_2 t^2 + \sum_{i=1}^{n} \beta_{2i} \Delta RealAgLand_{t-i} + \sum_{i=1}^{n} \mu_{2i} ChargeOff_{t-i} + \varepsilon_{2t}$,

where t is time; α, γ, τ, β, and μ are parameters to be estimated; n is the optimal number of lags; and ε is the error term of each equation that is estimated as a white noise process. VAR and subsequent orthogonal impulse response functions are estimated in SAS 9.1.

In order to estimate the VAR model, the number of lags must be determined. A total of one to ten lags were tested. To determine the optimal lag length, the following criteria were examined; the minimum Akaike Information Criterion and Schwarz Bayesian Criterion information tests, a stationary system (autoregressive characteristics polynomial roots are less

than one in absolute value), and errors are white noise (Jarque-Bera normality test). After ensuring these criteria were met, the optimal lag length was five. To ensure the VAR system captures the quadratic nature of the data, a time squared variable is added. The results of the VAR estimation are presented in table 1.

Interpreting the results in table 1 is difficult because signs on the lag variables change and there are cross equation feedbacks. In order to interpret the results of a VAR model, many studies in the time series literature do so through orthogonal impulse response functions. As discussed in Hamilton, an orthogonal impulse response is based on decomposing the estimated VAR model error terms or innovations into a set of uncorrelated components. After these uncorrelated components are obtained, the consequences of a one unit impulse or a one standard deviation shock of an endogenous variable is estimated in the VAR system. In effect, this shock is a multiplier that alters the forecast of the endogenous variables in the system.

Testing the effect of real agricultural land values on net loan charge offs is done through an orthogonal impulse response function. The variance/covariance matrix of innovations between real agricultural land values and net loan charge offs is $\begin{matrix} 1655.23 & -4.18 \\ -4.18 & 0.03 \end{matrix}$. Given the negative relationship between land values and charge offs and the objective of the VAR in this paper, a negative innovation (shock) in real agricultural land values is necessary to assess the rise in net loan charge offs. In addition, the estimator and the standardized shock process asymptotic properties are normal. Thus, estimating the $\Delta RealAgLand$ value as being negative to create a decline in the standardized shock of the orthogonal impulse response is appropriate.

Figure 5 shows the orthogonal impulse response of net loan charge offs to a negative shock in agricultural land values. The land value shock is equivalent to one-fourth of the decline

experienced at the peak of the 1980s farm debt crisis.[4] The upper bound in year 1 after the shock indicates net loan charge offs would rise by 0.2 percent. The modest rise would push net loan charge offs to around 0.6 percent; a level which has not been experienced since the late 1980s. The average response indicates the land value shock would remain in the system for 4 years. However, the lower bound is negative at year 2 meaning lenders would be able to recoup more collateral than their actual losses.

Loan Loss Reserves

One way to assess agricultural lenders' ability to respond to a rise in net loan charge offs is to analyze the loan loss reserves coverage ratio calculated by dividing loan loss reserves by nonaccrual loans (Table 2). Since 2003, the value of the ratio has declined, indicating that nonaccrual loans are increasing faster than loan loss reserves.

Agricultural banks had a coverage ratio equal to 1.87 in 2003 but it now stands at 1.22. The reduction in the ratio has occurred as non-accrual loans have grown faster than loan loss reserves. In the case of agricultural banks, this is partly due to the increased exposure agricultural banks have to the general economy and the current recession. However, the FCS has experienced a similar decline in their coverage ratio (1.98 to 1.12). Their total dollar loan loss reserves have dropped by more than half since 2003. Non-accrual loans have declined significantly since 2003 but have recently edged up. The largest contributing factor to the decline in FCS' coverage ratio is their significant loan volume growth.

Based upon their level of capital and exposure to agricultural loans, it appears that agricultural banks are better prepared to deal with a rise in net loan charge offs associated with a

[4] The differenced decline in real agricultural land values in 1985 was 161.19. The shock shown in figure 5 is 40.68. Thus, the orthogonal response of net loan charge offs to a decline in agricultural land values is about one-fourth of the magnitude experienced at the peak of the 1980s farm debt crisis.

land value shock than the FCS. Based on the estimated marginal increase in net loan charge offs (0.2 percent), agricultural banks and the FCS would experience an additional rise of $126 million and $333 million in loan losses, respectively. Both lenders would have adequate loan loss reserves to absorb this shock. However, agricultural banks would only deplete 5 percent of their loan loss reserves while the FCS would see their loan loss reserve reduced by 36 percent. Even though this shock is moderate in comparison to the 1980s, the FCS' coverage ratio would fall well below one.

Admittedly, these results show the difficulty of predicting the impact of a 1980s type crisis on loan charge offs (Gustafson, Pederson, and Gloy had a similar conclusion). The negative land value shock is estimated using data from an unusual event and lending practices have changed since the period (collateral based lending to cash flow based lending). Indeed, cash flow based lending may result in smaller loan losses than predicted using historical data. Another fact to consider is that profitability has been quite high for agricultural banks and the FCS. These earnings, if retained, can provide an important source of capital to absorb the shock.

Our simple model only estimates an immediate shock to the system and does not account for the complexity of the loan default process. Much additional research is needed to understand the relationship between loan defaults and ultimate losses on loans. Regardless, the analysis indicates that a *moderate* shock has the potential to significantly impact the balance sheet of agricultural lenders.

Conclusions and Implications

The current financial crisis presents some old and new challenges. For example, global demand for agricultural products has diminished while non-farm demand for agricultural land has

slowed. Three agricultural banks have failed recently. While their reasons for failure vary and are not directly attributable to the financial crisis, it certainly highlights how the challenges of a volatile agricultural environment are affecting lenders.

Agricultural land values are at historically high levels. Some might be interested to see if recent increases are sustainable. Many factors have contributed to the increase such as a robust farm economy, non-farm demand for land, and tax law changes like the 1031 exchange. Some of these factors are beginning to wane such as diminished non-farm demand for agricultural land. However, such concerns are not new. Similar questions arose before the farm crisis of the 1980s. It remains to be seen whether recent increases in land values will be sustained by increased future farm incomes. If not, there will likely be implications for agricultural lenders. However, it appears that farmers and agricultural lenders are in a better position to manage such declines than in the past.

In many respects, the lessons learned by farmers and agricultural lenders of the 1980s should better prepare them for what the future may hold. Agriculture production, however, is different in many respects from the 1980s. Global production of agricultural commodities continues to expand. Average farm size continues to grow. And, much of the value of agricultural production is increasingly produced by a decreasing percentage of producers. These changes in farm size and numbers will alter the relationship between agricultural lenders and agricultural producers. Such as a rise in default risk because the lending portfolio is increasingly concentrated among a few large borrowers.

Today's agricultural lending environment continues to change in unpredictable ways. Congress has eased the restrictions on the FCS so that associations can now lend money to consumers for the purchase of rural homes and to investors to operate rural businesses that

predominately serve agricultural producers. This has increased the diversity in the FCS portfolio making the System less susceptible to fluctuations in the agricultural credit market. The current economic and political climate portends changes in the regulation and monitoring of all banks, including those that predominately serve agriculture. Tighter lending standards, increased capital requirements, and additional government oversight are all possible outcomes of the broader economic and credit crisis. These changes could result in marginally credit-worthy borrowers paying higher interest rates or even not receiving any funds at all.

The amount of uncertainty that exists in financial, commodity, and agricultural markets makes for a difficult lending environment. Whether or not the agricultural economy experiences a substantial negative shock is difficult to predict. Nevertheless, agricultural lenders have changed to cash flow based lending, have high and stable earnings, raised capital above 1980s levels, and have borrowers that have undergone similar changes. The financial health of agricultural lenders appears to be positioned to weather a tumultuous environment.

References

Board of Governors of the Federal Reserve System. 2009. *Agricultural Finance Databook*. Available at http://www.federalreserve.gov/releases/e15 last accessed on May 7, 2009.

Burt, O.R. 1986. "Econometric Modeling of the Capitalization Formula for Farmland Prices." *American Journal of Agricultural Economics* 68(1): 10-26.

Economic Research Service. 2008. *Farm Balance Sheet*. Available at http://www.ers.usda.gov/Data/FarmBalanceSheet/ last accessed May 7, 2009.

Featherstone, A.M. and T.G. Baker. 1987. "An Examination of Farm Sector Real Asset Dynamics: 1910-85." *American Journal of Agricultural Economics* 69(3): 532-546.

Gustafson, C.R., G.D. Pederson, and B.A. Gloy. 2005. "Credit Risk Assessment." *Agricultural Finance Review*, 65(2):201-218.

Hamilton, J.D. 1994. *Time Series Analysis*. Princeton, NJ: Princeton University Press.

Melicahar, E. 1979. "Capital Gains Versus Current Income in the Farming Sector." *American Journal of Agricultural Economics*, 61(5):1085-1092.

McConnen, R.J. 1979. "Land Prices, Inflation, and Farm Income: Discussion." *American Journal of Agricultural Economics*, 61(5):1103-1104.

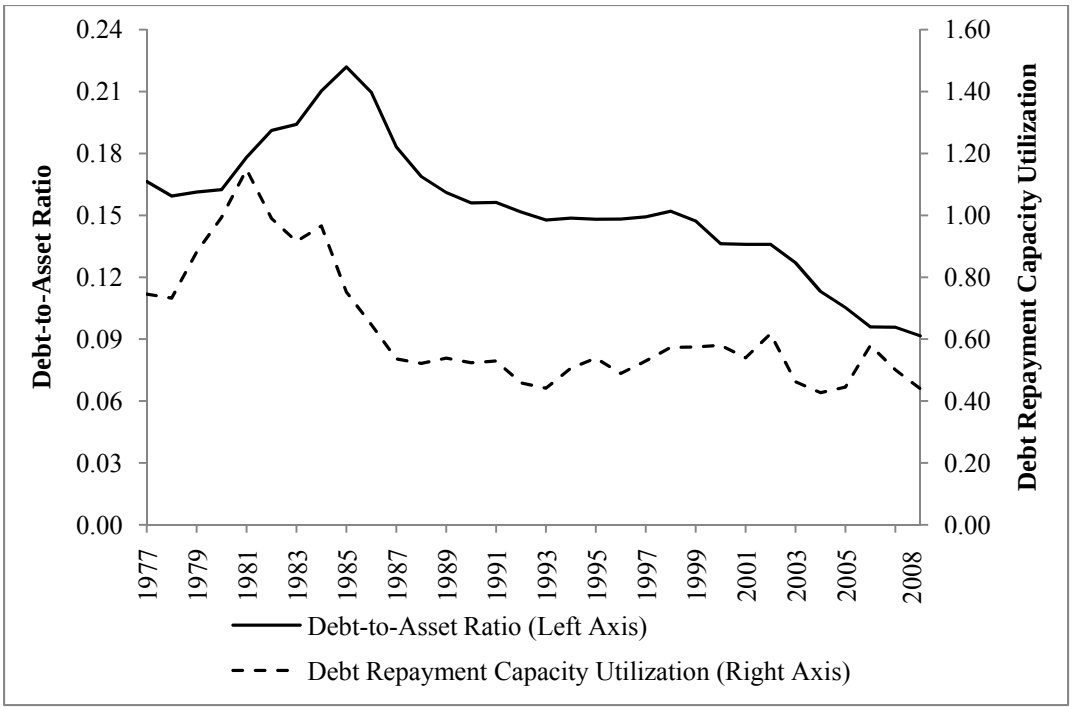
Moss, C.B. and A.L. Katchova. 2005. "Farmland Valuation and Asset Performance." *Agricultural Finance Review*, 65(2):119-130.

Peoples, K.L., D. Freshwater, G.D. Hanson, P.T. Prentice, and E.P. Thor. 1992. *Anatomy of an American Agricultural Credit Crisis: Farm Debt in the 1980s*. Lanham, MD: Rowman & Littlefield Publishers, Inc.

Plaxico, J.S. 1979. "Implications of Divergence in Sources of Returns in Agriculture." *American Journal of Agricultural Economics*, 61(5):1098-1102.

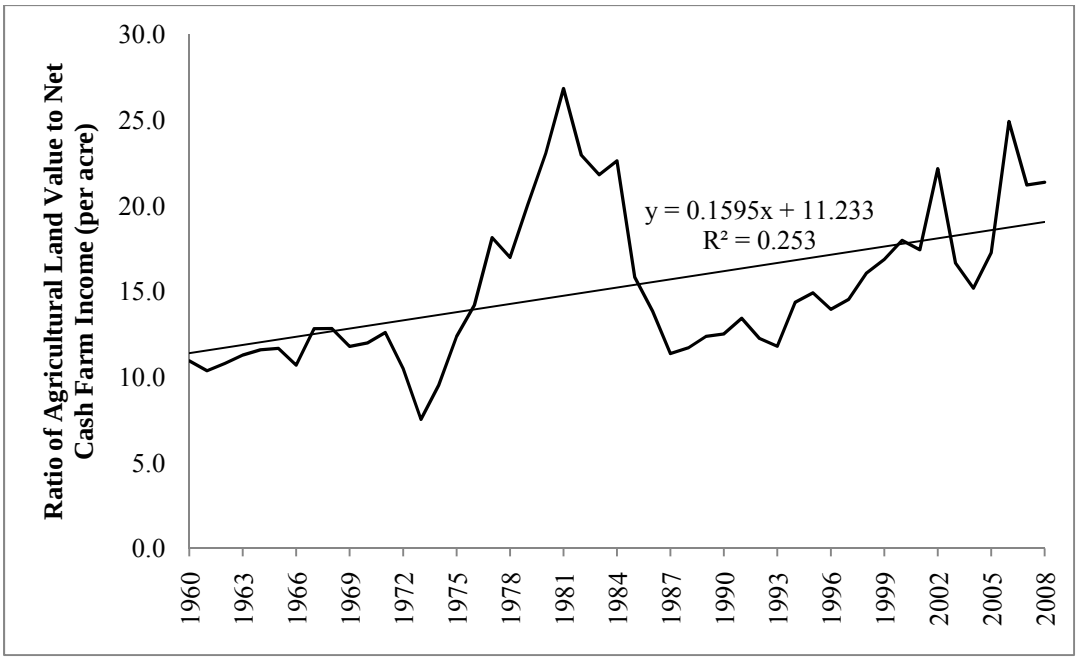
Reinsel, R.D. and E.I. Reinsel. 1979. "The Economics of Asset Values and Current Income in Farming." *American Journal of Agricultural Economics*, 61(5):1093-1097.

Sims, C.A. 1980. "Macroeconomics and Reality." *Econometrica* 48(1): 1-48.



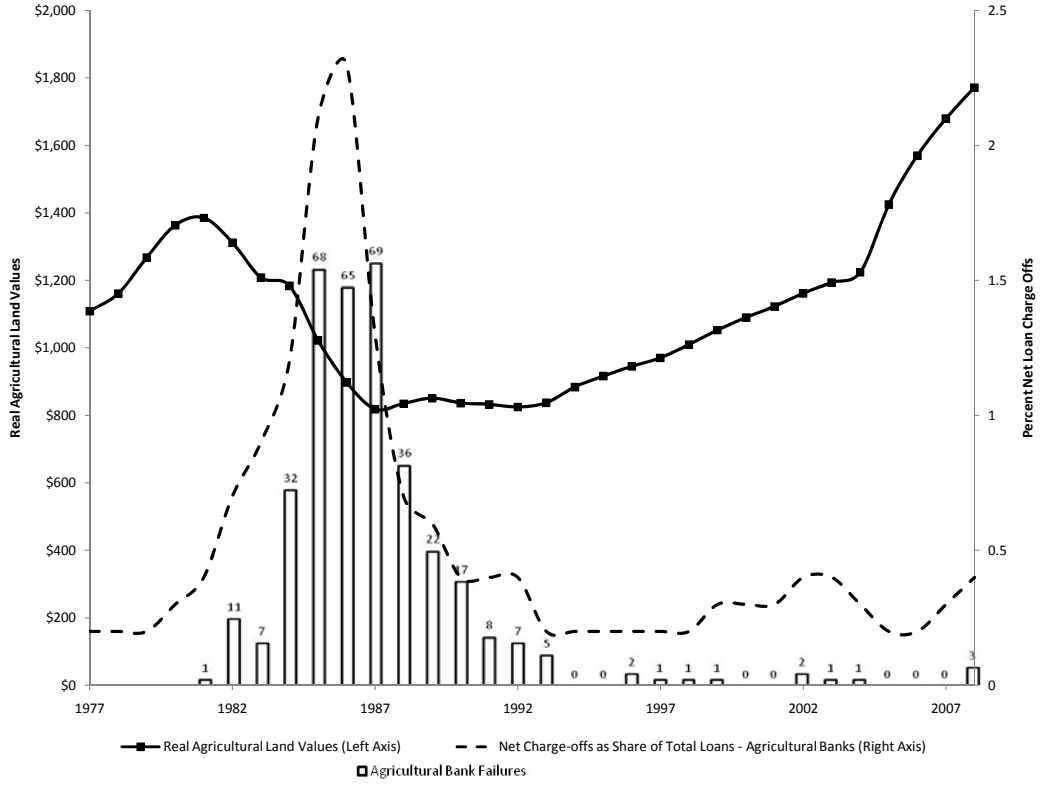
Source. United States Department of Agriculture Economic Research Service and the Agricultural Finance Databook.

Figure 1. Debt-to-asset ratio and debt repayment capacity utilization for the U.S. farm sector (1977 to 2008)



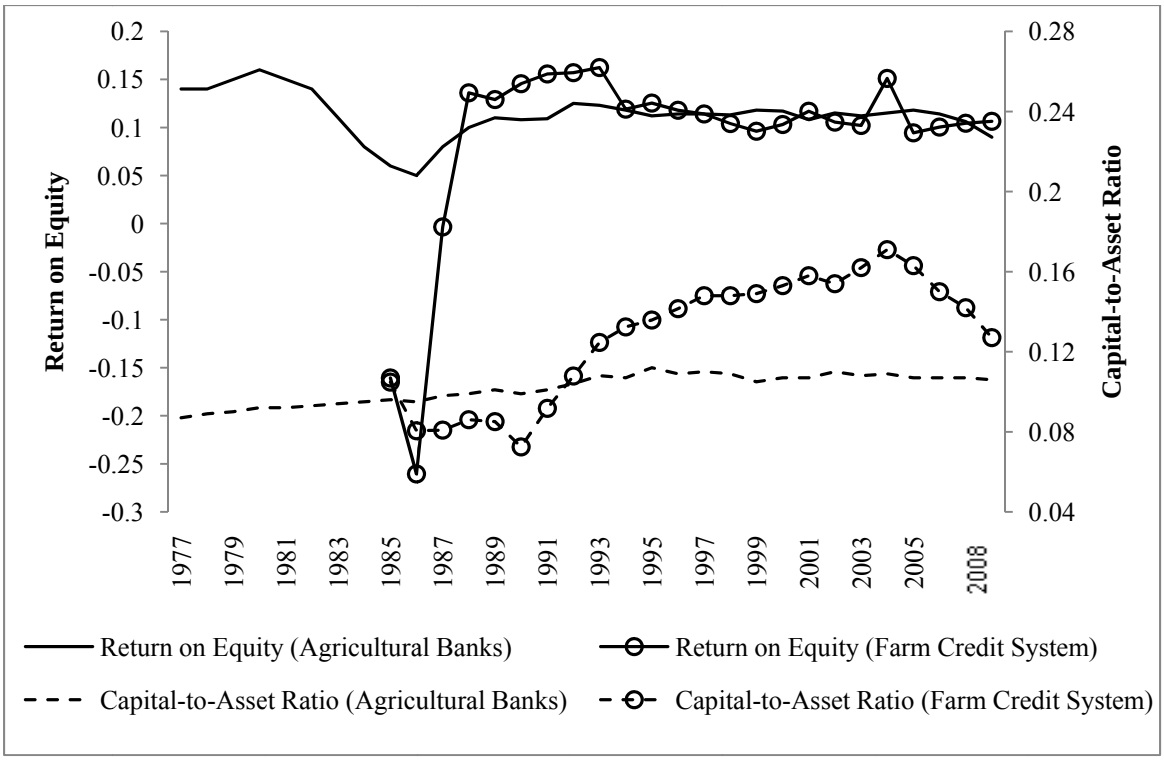
Source. United States Department of Agriculture Economic Research Service

Figure 2. Price-to-earnings ratio of agricultural land (1960 to 2008)



Source. United States Department of Agriculture Economic Research Service and the Agricultural Finance Databook.

Figure 3. Real agricultural land values (in 2000 dollars), net loan charge-offs, and agricultural bank failures (1977 to 2008)



Source. Agricultural Finance Databook and Farm Credit System Annual Reports.

Figure 4. Profitability and capital position of primary agricultural lenders

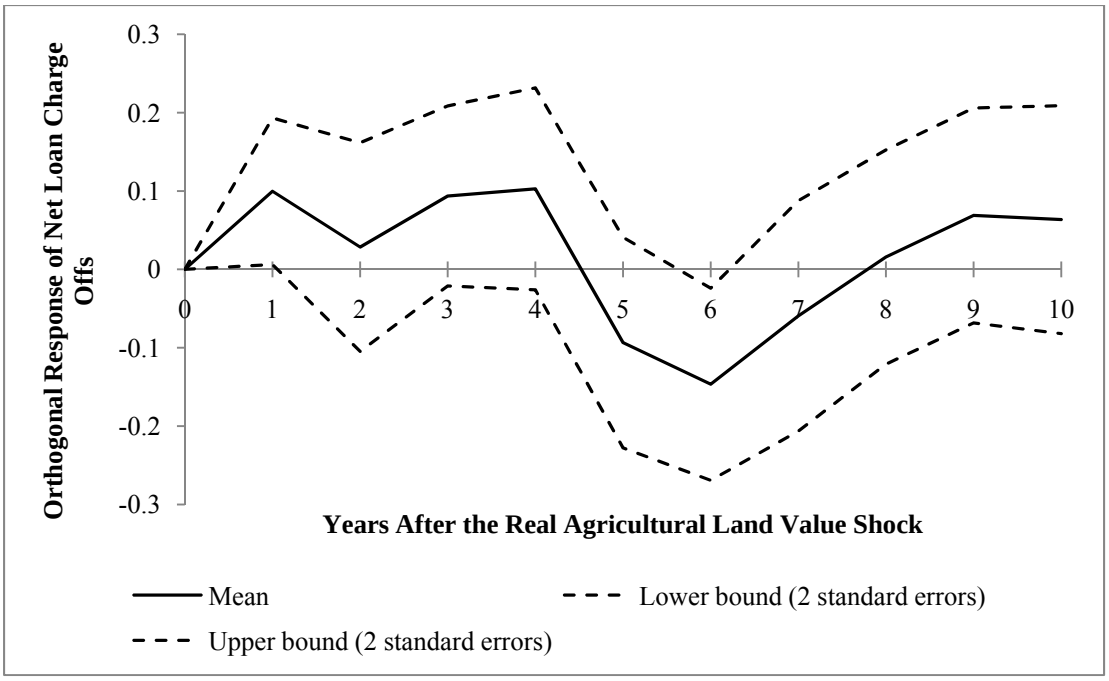


Figure 5. Response of net loan charge offs to an orthogonalized shock in real agricultural land values

Table 1. Estimated VAR Coefficients and Test Statistics for Real Agricultural Land Values and Net Loan Charge Offs

Statistic	Land Value Equation	Net Loan Charge Off Equation
R-square	0.85	0.95
Jarque-Bera normality test[a]	0.89	0.73
Granger causality for land value[b]	-	11.83**
Granger causality for net loan charge off[c]	10.73*	-
Independent variable	Regression Coefficients	
Intercept	211.67	0.57
Time trend	-21.06	-0.07
Time trend square	1.13*	0.002
ΔReal Ag Land Value $_{t-1}$	-0.53	0.001
ΔReal Ag Land Value $_{t-2}$	-0.45	-0.00003
ΔReal Ag Land Value $_{t-3}$	-0.38	-0.002
ΔReal Ag Land Value $_{t-4}$	-0.73	-0.0004
ΔReal Ag Land Value $_{t-5}$	-0.59	0.003
Net Loan Charge Off $_{t-1}$	-215.97**	1.27***
Net Loan Charge Off $_{t-2}$	65.58	-0.96**
Net Loan Charge Off $_{t-3}$	-71.26	0.63
Net Loan Charge Off $_{t-4}$	-10.32	-0.70*
Net Loan Charge Off $_{t-5}$	-54.12	0.52**

Note: Significant tests at the 10, 5, and 1 percent level are signified by *, **, and ***, respectfully.

a) Chi-squared test of the null hypothesis that the residuals represent a white noise process.

b) Wald test of future values of land values are influenced by past land values and past net loan charge offs.

c) Wald test of future values of net loan charge offs are influenced by past net loan charge offs and past land values.

Table 2. Total Agricultural Loans, Loan Loss Reserves, and Non-accrual Loans for Agricultural Lenders (in millions)

Type of Lender	Variable Name	2003	2004	2005	2006	2007	2008
Agricultural Banks	Total Agricultural Loans	$46,014	$48,772	$51,147	$54,983	$58,681	$62,796
	Loan Loss Reserves	$2,169	$2,196	$2,203	$2,350	$2,403	$2,697
	Non-accrual Loans	$1,161	$923	$804	$890	$1,245	$2,204
	Coverage Ratio	1.87	2.38	2.74	2.64	1.93	1.22
Farm Credit System	Total Agricultural Loans	$92,790	$96,367	$106,272	$123,436	$142,906	$161,423
	Loan Loss Reserves	$2,075	$792	$755	$734	$781	$936
	Non-accrual Loans	$1,049	$646	$524	$533	$512	$839
	Coverage Ratio	1.98	1.23	1.44	1.38	1.53	1.12

Note: Data is taken from call reports for agricultural banks and the Farm Credit Administration for the Farm Credit System.
Agricultural banks are defined based on the *Agricultural Finance Databook* definition. An agricultural bank has a proportion of farm loans to total loans that is greater than the unweighted average at all banks, which is approximately 14.5 percent each year.

Amounts are in millions of dollars.

Coverage ratio is loan loss reserves divided by non-accrual loans.