Farm Bankruptcies and Land Value Trends:

The Effects of Land Value Fluctuations on Financial Stress

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Abstract

This study examines the relationship between agricultural land value trends and farm financial stress as proxied by farm bankruptcies and agricultural loan delinquency rates. Farms are becoming more dependent on agricultural land values as evidenced by an increasing share of their assets tied to the value of agricultural land and a rising share of agricultural debt secured by agricultural land. A vector autoregressive (VAR) framework is utilized to facilitate Granger causality between agricultural land and financial stress. Preliminary results are mixed in that farm bankruptcies Granger cause agricultural land changes while agricultural land changes Granger cause loan delinquency changes.

Introduction

The aggregate value of agricultural land in the United States accounted for 83.3% of all farms' assets in 2016. This is an all-time high and a steady trend upward since 2010's share of 76.5%. Relatedly, 2009 was the last year prior to 2016 where agricultural land values declined as there has been a steady growth in agricultural land values since 1987 (see figure 1). Farm debt secured by agricultural land accounted for an all-time high of $109,000 per farm in 2016 and made up 59.7% of all farm related debt which was also an all-time high. Current trends indicate that a farm's portfolio of assets is becoming more concentrated in agricultural land and their share of debt secured by farmland is rising. A farm's exposure to risk for downturns in the agricultural land market has been rising due to these aforementioned trends and raises a concern to address how agricultural land performance will affect farms.

In the same vein, research on financial stress has generally maintained that agricultural land value – or changes in agricultural land values – are a determinant of farm financial stress. Typical measures of financial stress include farm bankruptcies or loan delinquency rates at the regional level as it is difficult to acquire farm level data which can form a panel of observations. The implicit assumption is that agricultural land values directly impact the farm economy.

A gap in the literature is evaluating if farm financial stress impacts agricultural land values. We aim to address how the relationship between trends in farmland prices affect the financial position of farmers by using farmer bankruptcy data as a proxy for financial stress. We conduct Granger causality tests with respect to financial stress as well as agricultural debt values with respect to agricultural land values. Our preliminary results indicate that land values both cause and are caused by measures of financial stress while debt levels do not appear to have a Granger causality relationship with land values. The paper proceeds with an overview of the relevant literature, our estimation strategy, examination of the data, results from our estimation, and finishes with a conclusion on the impact of this research.

Literature Review

As farmland values begin to rise, the farm assets increase and raise the question of the appropriate response for expanding operations. The expansion of farm operations may be partly debt financed, and indeed we see increases in debt-loads as land values begin to rise. Vice-versa, as farmland values decline so too does a farmer's assets and this can cause financial stress as well as concerns over scaling down its operation. The link between farmland values and financial stress is one which has an ebb and flow, yet there is surprisingly little research on this topic. Davies (1996) utilizes agricultural data from the United Kingdom from 1969 to 1985 to examine how agricultural land prices affect the rate of insolvency. Their analysis is time-series and uses a polynomial distributed lag in estimating how the agricultural trends affect insolvency – as well as controlling for interest rates and inflation. They find that insolvency is negatively related to the current price of land, but positively related to the preceding two years of land prices. This highlights the potential for a dynamic relationship between financial stress and farmland values, although the study does not use cross-sectional variation that a panel model allows.

To the extent that Chapter 12 is thought of as an indicator for farm failure, Davies (1996) addresses the question of whether bad managers or agricultural policy are at play for insolvency of farms with a focus on land values. They utilize data from England and Wales form 1969 to 1985 and find that the rate of insolvency was negatively related to the current land prices but the lag structure of their model suggests that the rate of insolvency could be positively related to land prices two years prior. Their results suggest that managers are increasing debt loads during periods of rising land values and that a period of falling land values following a rise in land values exacerbate financial stress for farms.

There has been a growing literature which uses farmer bankruptcies, as measured by Chapter 12 in the bankruptcy code, as a proxy for financial stress. Only farmers can file for Chapter 12. Dixon et al. (2002) published a paper that employs a panel data model that analyzes factors affecting Chapter 12 bankruptcies over the period 1986-2001. They use an estimated generalized least squares model with financial variables, farm structural variables, and policy and social variables. Their findings indicated economic conditions in the

economy are the best predictors of bankruptcy rates. In particular, increases in the unemployment rate are associated with increases in filing rates. Specific important predictors include: the lessening ability to service debt (positive effect), debt-to-asset ratio (negative), farm size (negative), net farm income (negative), and government payments (negative) but they did not look at farmland values as a predictor of bankruptcies. Dinterman, Katchova, and Harris (2016) utilize panel data techniques to look at Chapter 12 bankruptcies from 1997 to 2016 and find agricultural land to be significantly and negatively related to bankruptcies.

Empirical Strategy

Given two stationary time series, Y_t and X_t, if past values of X_t helps explain Y_t then it is implied that X_t Granger causes Y_t (Granger 1969). If the past values of X_t do not explain the Y_t series then there is no Granger causality. This can be formally represented as:

$$Y_t = \sum_{j=1}^{p} A_{11,j} Y_{t-j} + \sum_{j=1}^{p} A_{12,j} X_{t-j} + E_{1,t}$$

$$X_t = \sum_{j=1}^{p} A_{21,j} Y_{t-j} + \sum_{j=1}^{p} A_{22,j} X_{t-j} + E_{2,t}$$

where p is the optimal number of lags included in the model. Granger causality of X_t on Y_t occurs when the coefficients of $A_{12,j}$ jointly differ from 0 which can be econometrically tested through an F-test with the null hypothesis as non-causality, $A_{12,j} = 0$.

Data

Variables of interest for this paper involve agricultural land values, farm bankruptcies, agricultural delinquency rates, and farm debt – which all come from varying data sources. These data vary at either the annual or

quarterly level as well as the state or national level. Aside from different levels of variation (state versus national), the time period for each variable and their source differs.

Agricultural land values are available annually since 1910 from the USDA through their Quick Stats API, these are only annual level values and not available at a faster time interval. This is consistently available nationally as well as for most states since 1910 with the exceptions being Alaska and Hawaii which vary by 5 years instead of annually.

Data involving annual farm bankruptcies has two different sources which are a result of two different regimes in bankruptcy law. The USDA-ERS provides the first regime from 1899 to 1979 and measures all chapters of bankruptcy that farmers file under at the national level. Then due to procedural changes for the filing of bankruptcies, the data continue annually in 1987 but are only measured through Chapter 12 bankruptcies – which only farmers can file for – which omits Chapters 7, 11, and 13 that farmers may also file for. State level values for Chapter 12 become available in 2001 through uscourts.gov which also mark the beginning of quarterly level filing data for farm bankruptcies at both the state and national level.

National agricultural delinquency rates are available from the Federal Deposit Insurance Corporation (FDIC) at the quarterly level since 1987 (1991 for national delinquency rates related to agricultural land). Delinquencies are calculated by summing the total value of loans which are 30 to 89 days delinquent, more than 90 days delinquent, and in non-accrual status. The delinquency rate is then the total value of delinquent loans divided by the total value of loans. Starting from December of 1992, the FDIC maintains institution level data for every quarter which provides loan and delinquent loan values. These data can be aggregated to the state level to provide agricultural delinquency rates. However, prior to 2001 the FDIC classified all 30 to 89 day delinquent loan values to be confidential which marks a discrete change in how state level delinquency rates can be calculated.

Farm debt is available nationally since 1910 for every year through the Farm Income and Wealth team of USDA-ERS. In addition, in 1960 data on debt secured by farmland are available. Farm debt is not available at the quarterly or state level, which limits its applications.

Due to potential concerns with inflation, the real value of agricultural land values and farm debt are useful variables to consider although the nominal values may also be important. The GDP deflator is available beginning in 1929 and is used to convert nominal values into real in terms of 2009 dollars.

Annual Trends

Annual values are plotted over time in figure 1 for the relevant variables and summary statistics are given for their mean, standard deviation, Augmented Dickey-Fuller (ADF) test for non-stationarity, and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test for stationarity in table 1 (Dickey and Fuller 1979; Kwiatkowski et al. 1992). Of particular note is that agricultural land values – whether real or nominal – are upward trending and clearly non-stationary processes via both visual inspection and failure to reject the ADF test as well as the rejection of the KPSS test. The non-stationarity of debt and real estate debt – both are plotted in terms of real 2009 dollars – are clearly visible through their time series as well as the ADF test's failure to reject the presence of a unit root and KPSS test rejection of stationarity.

Our indicators of financial stress – bankruptcy rate per 10,000 farms and agricultural loan delinquency rate – are available across two different regimes. The pre-1979 regime only entails the bankruptcy rate and covers all forms of bankruptcy for farmers. There is a clear increase in farm bankruptcies around the Great Depression with another uptick prior to World War 2. The pre-1979 regime is a non-stationary process as evidenced by the stationarity tests. For the post-1986 regime, the bankruptcy rate and agricultural delinquency rate follow similar trends although their magnitudes are not comparable due to the differing units of observation. Both series have elevated values prior to 1990 relative to their stable rates afterwards. The ADF tests for both series post-1986 strongly reject the null of non-stationarity and it can be assumed these processes are stationary.

One method for dealing with non-stationary series is to transform the series in such a way that the series becomes stationary. We choose to convert all series into growth rates as a way to correct for non-stationarity and do so mainly because of the ease of interpretation.[1] The time series plots of percentage changes for the

[1] Other transformations were considered – first differences and detrending – and yielded similar results.

variables of interest are shown in figure 2 and their accompanying summary statistics are in table 2.

Via visual inspection, the ADF tests, and KPSS tests, all series are stationary at the 10% level and all but the debt in real estate are significant at the 3% level. The value of agricultural land – which is in real terms – has grown by approximately 2% annually since 1910.

As another inspection of how these series correlate with agricultural land values, we estimate cross-correlation functions of the form:

$$\rho_{y_t, x_{t+h}} = \frac{cov(y_t, x_{t+h})}{\sigma_y \sigma_x}$$

where h represents the lag time period. A positive value of h indicates that the x series is h time periods in the future and a negative value reflects a lag of x by h time periods in the past. Since these are simple correlations, a positive value of h would imply that the y series is lagged h time periods in relation to x and vice-versa for the negative values of h

Table 3 displays the cross-correlations with the respective variables as x in relation to the percentage change in agricultural land values, y, and an asterisk indicating significance at the 5% level. Of note, the pre-1979 bankruptcy rate change does not appear to hold significance to the change in agricultural land values while the post-1986 bankruptcy rate change maintains a positive relationship with agricultural land values through the lagged 2nd and 3rd periods. This would indicate that

The change in agricultural delinquency rates are negatively related to current land values – ie that an increase in land values reduces the agricultural delinquency rate in the current time period – but delinquency rates appear to rise (fall) in the 3rd and 4th periods following an increase (decrease) in land values. This result can also be interpreted that a rise in land values 3 and 4 periods in the past lead to an increase in current agricultural delinquency rates. The mechanism for this relationship cannot be identified through simple correlations, but it is interesting to note that there appears to be a lengthy amount of time for feedback to occur between land values and delinquency rates.

The relationship between changes in agricultural land values and a change in debt values – both total and for debt secured by agricultural land – maintain similar relationships in terms of both lags and magnitudes. Both debt and land value changes are positively related, implying a rise (fall) in agricultural land values corresponds to a rise (fall) in debt. The lagged structure indicates that the future changes in debt are positively related to current agricultural land changes for up to 4 periods while the past value of debt is only related to current agricultural land changes for the previous period. The skewed nature of this correlation is suggestive that agricultural land values cause future changes in debt, but this cannot be confirmed as these are only correlations and causation cannot be accurately assessed. Because of this, we turn to the Granger causality tests in an attempt to address causal claims.

Results

To evaluate whether or not financial stress affects land values – or the other way around – we turn to Granger causality tests. We similarly evaluate how the debt value changes affect agricultural land in this light. Because the optimal number lags is a model selection issue, we determine the lags based on Akaike information criterion (AIC) for each model which resulted in 4 lags for each model.

Table 4 displays results where the agricultural land change is the Y_t and the null hypothesis $A_{12,j} = 0$ is tested to determine if the variables of interest Granger cause agricultural land changes. The results indicate that the change in bankruptcy rates for the post-1986 regime Granger cause agricultural land changes. None of the other variables appear to Granger cause agricultural land changes. This result is interesting in that it suggests financial stress as measured with farm bankruptcies have influence over the changes in agricultural land values. Given the cross-correlation of farm bankruptcies and agricultural land values indicate a rise in bankruptcies eventually lead to an increase in agricultural land values, this result becomes puzzling as to why this may be. A more sophisticated model of the process between farm bankruptcies and agricultural land values is needed to address this question.

In turning to the other direction of causality – ie that changes in agricultural land values Granger cause

the other variables of interest – table 5 displays the results. Changes in agricultural land values appear to Granger cause agricultural delinquency rates, none of the other variables indicate a causal relationship from changes in agricultural land values. In light of the previous results, this is of interest in that agricultural delinquency rates are also meant to proxy financial stress yet they are caused by changes in agricultural land changes. The cross-correlation function indicates that an increase (decrease) in agricultural land values eventually lead to an increase (decrease) in the agricultural delinquency rate. This may raise concern that the strategies of debt accumulation by farms may be overzealous, which would lead to a situation where net income of a farmer may not cover their debt costs and lead to the delinquency.

Of further interest is that changes in debt values do not appear to Granger cause or are Granger caused by changes in agricultural land values. Previous values of changes in debt value or in land value do not appear to have predictive power.

Conclusions

Through the lens of Granger causality, this paper addresses the relationship between agricultural land values and financial stress as measured by farm bankruptcies and agricultural delinquency rates. Our results indicate that changes in agricultural land values both causes and is caused by measures of financial stress. The delinquency rate appears to be a lagging indicator of farm financial stress with respect to agricultural land values while the farm bankruptcy rates appear to lead changes in agricultural land values. No causal relationship between debt and land values is evident, although the data indicate that these processes co-move.

These results pertain to national level trends in the agricultural sector and at the annual level. At such an aggregated level, it may be difficult to find relationships across variables due aggregation issues and potential measurement error which may be reason for the lack of finding debt and agricultural land values have a causal relationship as defined through Granger causality. However in light of this, it is interesting to find directionality between agricultural land value changes and financial stress.

Future research on how the different measures of financial stress impact agricultural land values as well as how they are impacted through changes in agricultural land values. Our findings that farm bankruptcies impact future agricultural land value changes is a curious result that merits further research in determining land values. The current methodology for valuing agricultural land utilizes expectations of future income streams from the productivity of the land and has not yet used farm bankruptcies as a potential factor which may have an affect on expectations.

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Figures

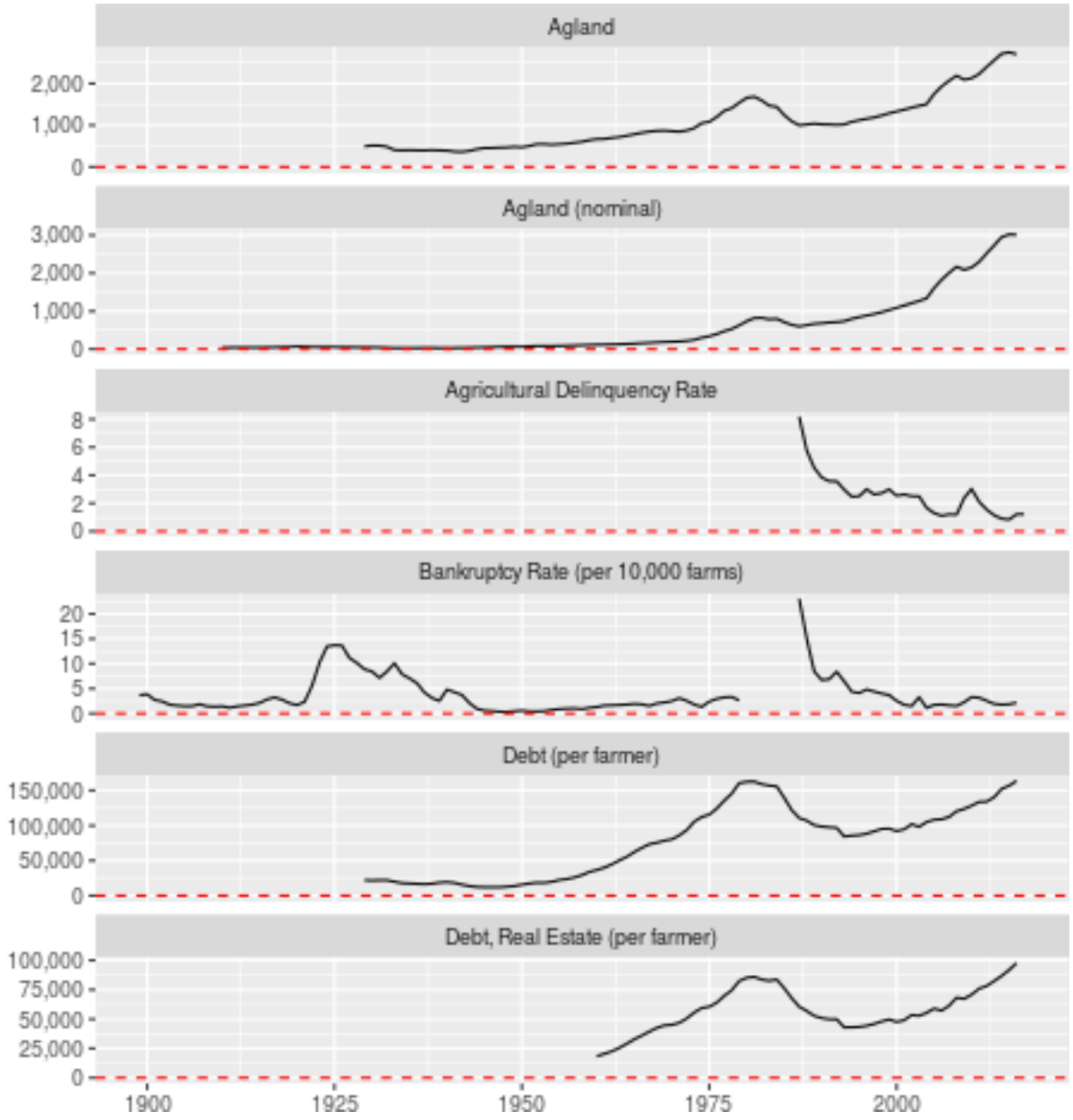

Figure 1: Annual Values

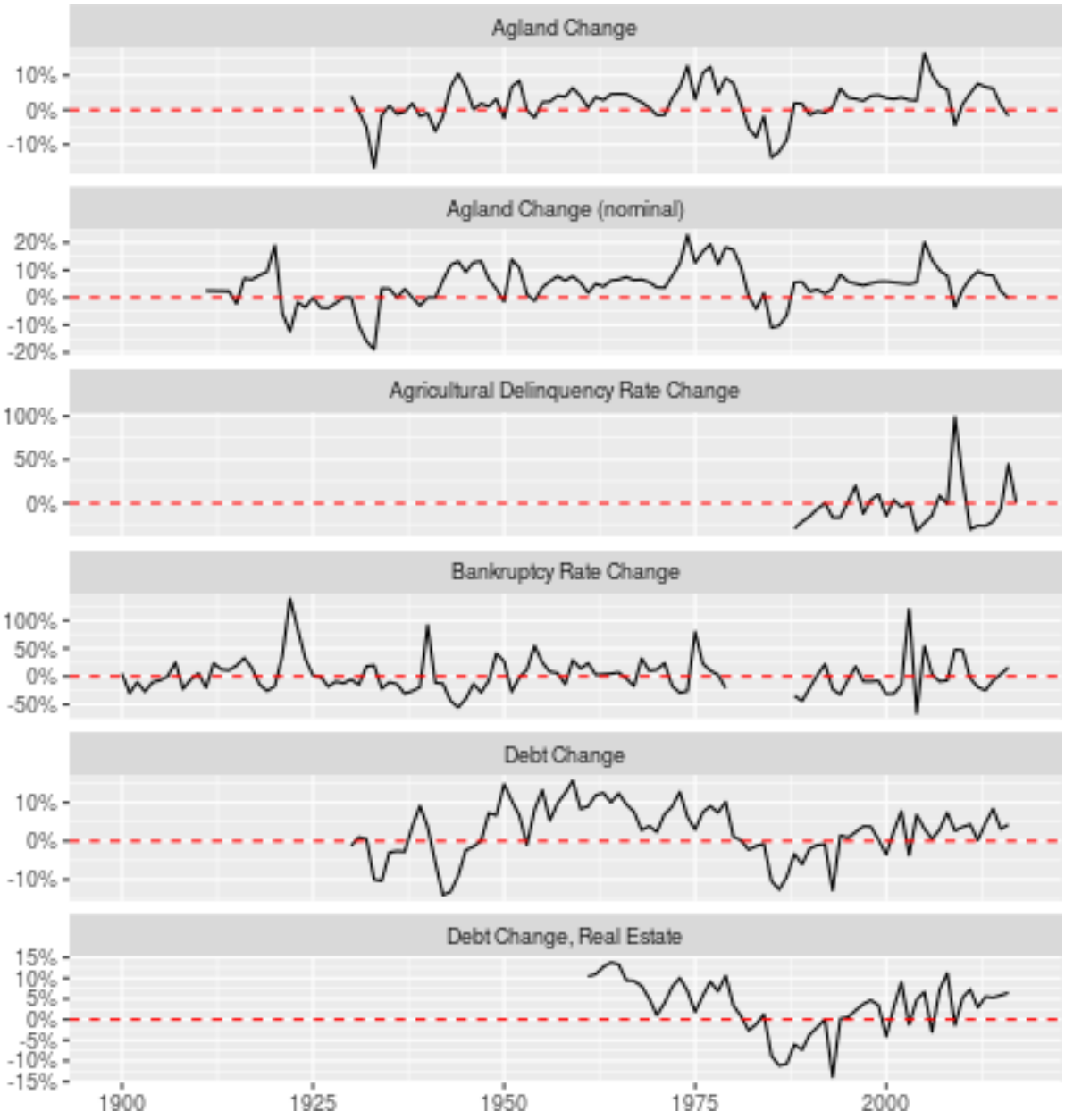

Figure 2: Percentage Changes

Tables

Table 1: Summary Statistics, in terms of levels with 2009 dollars

variable	Mean	S.D.	ADF Stat	ADF P-Value	KPSS Stat	KPSS P-Value
Agland	$1,050	$624	0.006206	0.99	2.407	0.01
Agricultural Delinquency Rate	2.58	1.54	-5.996	0.01	1.143	0.01
Bankruptcy Rate (post-1986)	4.55	4.58	-8.348	0.01	0.9588	0.01
Bankruptcy Rate (pre-1979)	3.32	3.29	-1.464	0.795	0.4652	0.0495
Debt (per farmer)	$76,038	$50,336	-0.9164	0.946	2.31	0.01
Debt, Real Estate (per farmer)	$57,513	$18,973	-0.7634	0.96	0.875	0.01

Table 2: Summary Statistics, in terms of percentage changes

variable	Mean	S.D.	ADF Stat	ADF P-Value	KPSS Stat	KPSS P-Value
Agland	2.11%	5.39%	-4.794	0.01	0.2206	0.1
Agricultural Delinquency Rate	-3.43%	26.3%	-4.029	0.0213	0.1365	0.1
Bankruptcy Rate (post-1986)	-2.28%	35.7%	-6.395	0.01	0.2787	0.1
Bankruptcy Rate (pre-1979)	3.53%	31%	-5.719	0.01	0.07146	0.1
Debt (per farmer)	2.56%	6.85%	-3.7	0.0294	0.2616	0.1
Debt, Real Estate (per farmer)	3.22%	6.36%	-3.399	0.0651	0.6573	0.0174

Table 3: Cross-Correlations against Land Value Change

Lags:	Bankruptcy pre-1979	Bankruptcy post-1986	Delinquency Rate	Debt	Debt, Real Estate
-7	-0.0732	-0.1182	-0.1613	0.0193	-0.0961
-6	0.0085	-0.4082*	-0.1153	0.0625	-0.0501
-5	0.0958	-0.002	0.1771	0.1171	0.004
-4	0.1935	-0.0179	0.3157	0.1945	0.1512
-3	0.2582	0.3764*	0.2614	0.2114*	0.2523
-2	0.162	0.5542*	0.0588	0.1578	0.2208
-1	-0.1532	-0.1203	-0.2461	0.3027*	0.3859*
0	-0.2601	0.0061	-0.494*	0.4337*	0.564*
1	0.0832	-0.0675	-0.0366	0.4084*	0.4314*
2	0.2498	0.0712	0.3481	0.4028*	0.4906*
3	0.2328	0.2087	0.3762*	0.4086*	0.4942*
4	0.189	0.3471	0.6034*	0.2733*	0.3218*
5	0.1972	0.1534	0.061	0.1746	0.2513
6	0.112	-0.1327	-0.3274	0.1508	0.1812
7	-0.2287	-0.1101	-0.3101	0.1313	0.1319

Table 4: Granger Causality Tests, Agricultural Land Changes is caused by

	F Statistic	P-Value
Bankruptcy pre-1979	1.816	0.146
Bankruptcy post-1986	7.911	0.001
Delinquency Rate	0.795	0.545
Debt	1.397	0.243
Debt, Real Estate	0.782	0.543

Table 5: Granger Causality Tests, for Agricultural Land Changes causes

	F Statistic	P-Value
Bankruptcy pre-1979	0.812	0.526
Bankruptcy post-1986	1.281	0.319
Delinquency Rate	4.602	0.012
Debt	1.546	0.198
Debt, Real Estate	1.649	0.18