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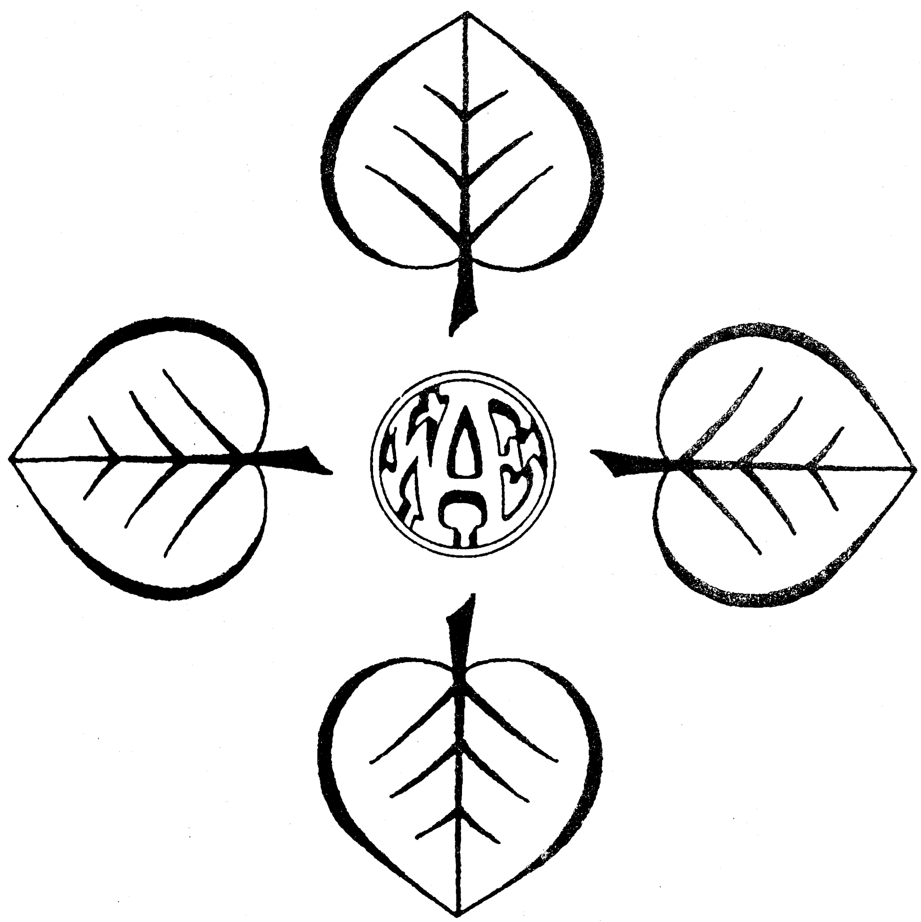

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The Cyclical Behavior
of Agricultural Land Prices

H. Alan Love
Texas A&M University
Deqin Cai
Oregon State University

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Nonparametric statistics are used to analyze the volatility, persistence, and comovement of agricultural land prices in 48 states for the period 1910-1989. Our main focus is on possible changes in the cyclical behavior of land prices after agricultural policies were introduced in 1933. Two important characteristics that are compared across time periods are the volatility and persistence of short-run movements in real land prices. We analyze whether short-run fluctuations have become less extreme and whether the tendency of shocks to have permanent or transitory effects has changed after agricultural policies were introduced. Correlation of short-term price movements across states is also investigated to determine if macroeconomic or sectoral shocks dominate or if individual land price series move in different ways. The methods used in this study were recently applied by Romer to 38 annual production series to investigate business cycles in the US.

Policy Issues

Two important policy issues can be illuminated by examining lengthy land price series behavior. First, since land is the fixed resource used in agricultural production, land prices are determined by the discounted stream of future earnings. Effective agricultural policies should reduce farm income variability and, hence, dampen fluctuations in anticipated land price. If agricultural policies have been effective, we would expect land price fluctuations in each state to become more stable after their introduction. Second, the relative importance of macroeconomic and sector-specific shocks is not well understood. If macroeconomic factors dominate land price movement, price in each state should respond similarly to shocks. If, however, land prices in some states tend to respond to shocks differently than land prices in other states, this would indicate state-specific and possibly sector-specific factors are most important.

Data Detrending and Differencing

Annual land price data are available from USDA for the years 1910-1989. In the analysis that follows, data are divided into the pre-agricultural policy period 1910-1933 and the agricultural policy period 1947-1989. These periods are delineated as period one and period two, respectively. The war years were dropped from analysis because of war time price controls. Land prices are deflated by the Consumer Price Index available from the Bureau of Labor Statistics. Following Cochrane, Campbell and Mankiw, and Romer, we use the log differences of price data in our analysis. This insures data stationarity but does not a priori force trend-reverting behavior on the data as would detrending (Campbell and Mankiw). Price data used in analysis can be interpreted as growth rates.

Nonparametric Statistics

Three summary statistics are used to analyze the transformed land price data. Standard deviation is used to measure price volatility. Shock persistence -- the tendency of a time series not to be trend-reverting after an innovation in price -- is measured using Cochrane's recently proposed nonparametric estimator (Cochrane; Campbell and Mankiw). In the long-run land price fluctuations should be transitory; after a shock, price should be trend-reverting. Cochrane's estimator is based on the weighted average of the first several sample autocorrelations.

$$(1) \qquad \hat{V}^k = 1 + 2\sum_{j=0}^{k}\left(1 - \frac{j}{(k+1)}\right)\hat{\rho}_j$$

where $\hat{\rho}_j$ is the j th sample autocorrelation. Campbell and Mankiw show that a simple transformation of Cochrane's $\hat{V}^k$ allows interpretation of the transformed statistic as $A^k(1)$ in the following equation:

$$(2) \qquad \Delta y_t = \beta + A^k(L)e_t$$

If $A^k(1) = 0$, then an innovation in the land price growth rate is completely dissipated in later periods. If $A^k(1) = 1$, then growth in land prices is a random walk. And if $A^k(1) > 1$, then the trend growth rate in land prices is permanently changed. Campbell and Mankiw's transformation is given by:

$$(3) \qquad \hat{A}^k = \sqrt{\frac{\hat{V}^k}{\left(1 - \hat{\rho}_1^2\right)}}$$

where $\hat{\rho}_1^2$ is the square of the first sample autocorrelation of the series. Campbell and Mankiw give the standard error of $\hat{V}^k$ as:

$$(4) \qquad SE[\hat{V}^k] = \frac{\hat{V}^k}{\sqrt{\frac{3}{4}\frac{T}{(k+1)}}}$$

The standard error for $\hat{A}^k$ can be computed from (3) and (4) using the delta method.

Finally, factor analysis is used to describe the covariance relationships among the growth in land prices in various states in terms of unobservable, random quantities called factors. Factor analysis decomposes the movement of each series in a group into parts that are due to distinguishable, but unobservable, common factors and a disturbance that is associated with only with that particular series. Johnson and Wichern present the theoretical foundations and computational details of factor analysis.

Volatility

Standard deviations of land price growth are presented in table 1. The third column is the ratio of period 2 standard deviation to period 1 standard deviation. Numbers larger than one indicate an increase in volatility. Completely effective agricultural policies should reduce land price volatility. It is conceivable, however, that macroeconomic conditions have destabilized agriculture land prices even though policy has had a dampening effect. A pattern is immediately apparent in table 1. Standard deviations have increased in important agricultural states, particularly those in the mid-west and great plains, and have decreased in less important agricultural states. Important exceptions in this pattern are California and Texas, both major agricultural states where volatility has decreased. The hypothesis that standard deviations have not changed between the two periods can be rejected only for states marked with a * at the 15% significance level.

Persistence

Nonparametric persistence estimates, $\hat{A}^k$, are given in table 2 for periods one and two. The third column is the asymptotic t-ratio for the test that persistence has not changed between the first and second periods. In the first period, before agricultural policies were introduced, innovations in land price growth appear to dissipate quickly; $\hat{A}^k$ is less than one for nearly all states. After agricultural policies were introduced, innovations in land price growth appear to permanently shift trend growth. Persistence estimates in important agricultural states increased to about two after agricultural policies were introduced. In states where agriculture is less important, persistence estimates do not increase as much, and in some states, persistence estimates actually decline in the second period. The hypothesis that persistence has not changed between the two periods can be rejected for states marked with a * at the 15% significance level.

These results have a two important implications. First, increased persistence measures in the post-policy period suggest that permanent shocks have become more important. Alternatively, the ability to recover from external shocks has diminished in states where persistence has significantly risen. One possibility is that farm programs have made shocks more persistent by reducing down-side profit risks while maintaining upward revenue flexibility. When economic conditions worsen, farm programs protect farmers from economic loss, but as conditions improve, farmers benefit (Rausser, Chalfant, Love, and Stamoulis). Second, persistence estimates greater that one in the post-policy period indicate that the price series are not stationary, characterizing a series that will continue to grow from its previously forecast value following a shock (Campbell and Mankiw).

Factor Analysis

Factor analysis results from SAS's initial factor method are presented in table 3 for land price growth and for the ratio of government transfer payments to total state agricultural cash receipts. The second data set measures agricultural program importance in a state, and is included for factor loading comparisons. Government payment and agricultural cash receipt data are from Agricultural Statistics. Both analyses are for the post-policy period, 1947-1989. If factor loadings in the two data sets result in similar state groupings, the proposition that agricultural programs help explain shock persistence in the second period gains support. Factor loadings indicate that a single common factor accounts for a significant part of the total variation in land price growth. The interest rate is a likely candidate for this unobservable common factor. The second factor groups states into two categories. Those with negative factor loadings, important agricultural states, and those with positive factor loadings, less important agricultural states. This state grouping is consistent with both the volatility and persistence groupings. Factor loadings for the share of state farm cash receipts from government programs result in a similar state grouping. Less important agricultural states have a negative loading on factor two while important agricultural states have a positive factor two loading.

Conclusions

Results indicate that volatility in land price growth increased after farm policies were introduced. In addition, shocks have had a more persistent influence on agricultural land price growth since farm policies were introduced. Evidence indicates that farm programs may have played an important role, however, other interpretations are possible. This analysis focuses attention on the possibility that agricultural programs may have had a destabilizing effect on the sector.

References

Campbell, J.Y. and G. Mankiw, "Are Output Fluctuations Transitory?" Quarterly Journal of Economics, 102(1987):857-880.

Cochrane, J.H. "How Big is the Random Walk in GNP?" Journal of Political Economy, 96(1988):893-920.

Johnson, R.A. and D.W. Wichern, Applied Multivariate Statistical Analysis. 2nd edition, Prentice-Hall, Englewood Cliffs, NJ, 1988.

Rausser, G.C., J.A. Chalfant, H.A. Love, and K. Stamoulis, "Macroeconomic Linkages, Taxes, and Subsidies in the U.S. Agricultural Sector," American Journal of Agricultural Economics, 68(1986):399-412.

Romer, C.D. "The Cyclical Behavior of Individual Production Series, 1889-1984," Quarterly Journal of Economics, 105(1991):1-31.

U.S.D.A. U.S. Agricultural Land Prices, 1910-1989. Economic Research Service, U.S.D.A., Washington, D.C. 1989.

U.S.D.A. Agricultural Statistics, U.S.D.A., Washington, D.C., various issues.

U.S. Bureau of Labor Statistics, Department of Commerce, Washington, D.C., various issues.

Table 1 Standard Deviation of Growth in Land Prices

Region	State	Period 1	Period 2	Ratio(2/1)
New England	Connecticut	0.069	0.038	0.563*
	Maine	0.058	0.049	0.840
	Massachusetts	0.062	0.039	0.635*
	New Hampshire	0.074	0.048	0.650*
	Rhode Island	0.078	0.057	0.734
	Vermont	0.066	0.048	0.729
Mid-Atlantic	Delaware	0.061	0.059	0.975
	Maryland	0.055	0.060	1.089
	New Jersey	0.074	0.058	0.776
	New York	0.057	0.044	0.780
	Pennsylvania	0.061	0.058	0.959
North Central	Illinois	0.064	0.090	1.414
	Indiana	0.056	0.087	1.556*
	Iowa	0.086	0.106	1.242
	Michigan	0.060	0.062	1.028
	Minnesota	0.067	0.094	1.411
	Missouri	0.058	0.077	1.324
	Ohio	0.051	0.078	1.513*
	Wisconsin	0.054	0.063	1.168
Plains	Kansas	0.064	0.071	1.112
	Nebraska	0.059	0.091	1.524*
	North Dakota	0.050	0.078	1.356
	Oklahoma	0.064	0.068	1.058
	South Dakota	0.069	0.072	1.040
	Texas	0.068	0.061	0.889
Southeast	Alabama	0.068	0.059	0.861
	Arkansas	0.069	0.071	1.038
	Florida	0.109	0.078	0.720
	Georgia	0.084	0.060	0.713
	Kentucky	0.048	0.055	1.159
	Louisiana	0.064	0.081	1.256
	Mississippi	0.094	0.072	0.762
	North Carolina	0.077	0.051	0.663*
	South Carolina	0.112	0.055	0.497*
	Tennessee	0.054	0.051	0.943
	Virginia	0.059	0.050	0.863
	West Virginia	0.048	0.065	1.363
Northwest	Colorado	0.073	0.063	0.870
	Idaho	0.058	0.059	1.013
	Montana	0.058	0.064	1.116
	Oregon	0.076	0.057	0.747
	Washington	0.063	0.058	0.916
	Wyoming	0.105	0.067	0.640*
Southwest	Arizona	0.101	0.072	0.715
	California	0.083	0.065	0.793
	Nevada	0.073	0.080	1.020
	New Mexico	0.089	0.070	0.780
	Utah	0.055	0.067	1.219

Table 2 Persistence Measures

Region	State	Period 1	Period 2	t-ratio
New England	Connecticut	1.547	1.755	0.17
	Maine	1.129	1.401	0.34
	Massachusetts	1.681	1.339	-0.29
	New Hampshire	1.135	2.051	0.77
	Rhode Island	1.703	1.075	-0.51
	Vermont	0.856	2.380	1.08
Mid-Atlantic	Delaware	1.309	1.748	0.40
	Maryland	0.929	1.663	0.86
	New Jersey	1.643	1.168	-0.41
	New York	1.528	1.368	-0.15
	Pennsylvania	1.255	1.426	0.19
North Central	Illinois	0.891	1.918	1.07
	Indiana	0.903	2.042	1.10*
	Iowa	1.188	2.037	0.76
	Michigan	0.694	1.918	1.25*
	Minnesota	1.252	2.159	1.36*
	Missouri	0.889	1.752	0.95
	Ohio	0.809	1.797	1.11*
	Wisconsin	0.614	2.320	1.36*
Plains	Kansas	0.703	2.109	1.33*
	Nebraska	0.689	1.547	1.31*
	North Dakota	0.918	2.058	1.07
	Oklahoma	0.720	1.950	1.23*
	South Dakota	0.974	1.447	0.67
	Texas	0.837	1.194	0.69
Southeast	Alabama	0.823	1.634	0.99
	Arkansas	0.967	1.854	0.89
	Florida	1.097	2.001	0.84
	Georgia	0.756	1.786	1.11*
	Kentucky	0.919	1.987	0.98
	Louisiana	0.732	1.799	1.22*
	Mississippi	0.521	1.777	1.50*
	North Carolina	1.142	1.587	0.48
	South Carolina	0.675	1.692	1.23*
	Tennessee	0.830	2.019	1.10
	Virginia	0.610	1.418	1.33*
	West Virginia	0.937	1.737	0.86
Northwest	Colorado	0.673	1.755	1.27*
	Idaho	0.694	2.607	1.33*
	Montana	1.054	1.795	0.74
	Oregon	0.821	2.139	1.16*
	Washington	0.912	1.884	1.02
	Wyoming	0.688	1.932	1.22*
Southwest	Arizona	1.783	1.456	-0.23
	California	1.029	2.037	0.96
	Nevada	1.002	1.233	0.38
	New Mexico	0.987	1.225	0.39
	Utah	1.018	2.310	0.97

Table 3 Factor Analysis

Region	State	Land Price 1	Land Price 2	GovtPay/Revenue 1	GovtPay/Revenue 2
New England	Connecticut	.884	.430	.142	.889
	Maine	.915	.380	.604	.394
	Massachusetts	.795	.591	.190	.901
	New Hampshire	.834	.513	.701	.262
	Rhode Island	.882	.427	.076	.313
	Vermont	.916	.373	.148	.910
Mid-Atlantic	Delaware	.984	.059	.862	.144
	Maryland	.984	.063	.923	.100
	New Jersey	.933	.220	.886	-.062
	New York	.936	.224	.946	.093
	Pennsylvania	.984	.108	.869	.030
North Central	Illinois	.905	-.364	.853	-.028
	Indiana	.930	-.326	.950	-.042
	Iowa	.875	-.434	.880	-.024
	Michigan	.981	-.139	.966	-.031
	Minnesota	.935	-.321	.915	-.033
	Missouri	.974	-.183	.930	-.084
	Ohio	.944	-.272	.975	-.039
	Wisconsin	.979	-.134	.860	.012
Plains	Kansas	.927	-.339	.927	-.088
	Nebraska	.952	-.262	.639	.648
	North Dakota	.982	-.148	.940	-.106
	Oklahoma	.982	-.138	.928	-.055
	South Dakota	.978	-.161	.924	.033
	Texas	.947	.168	.304	-.191
Southeast	Alabama	.993	.081	.778	-.189
	Arkansas	.982	-.079	.841	-.217
	Florida	.964	.191	.593	-.018
	Georgia	.988	.023	.902	-.049
	Kentucky	.996	-.041	.923	.146
	Louisiana	.973	-.107	.688	-.168
	Mississippi	.984	-.081	.848	-.262
	North Carolina	.991	.065	.913	-.081
	South Carolina	.990	.012	.893	-.162
	Tennessee	.997	.029	.892	-.182
	Virginia	.982	.166	.930	-.064
	West Virginia	.966	.033	.884	.122
Northwest	Colorado	.993	-.025	.648	-.020
	Idaho	.976	-.176	.944	-.011
	Montana	.992	-.075	.886	-.107
	Oregon	.976	-.098	.946	.019
	Washington	.975	-.077	.933	-.111
	Wyoming	.989	-.046	.762	.288
Southwest	Arizona	.952	.096	.749	-.299
	California	.834	-.048	.875	-.267
	Nevada	.960	.011	.752	.063
	New Mexico	.985	.002	.843	.038
	Utah	.957	-.070	.828	.272