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Farmland Prices and the Real Interest Rate on Farm Loans

Karl Gertel

Abstract. *While economists agree on the importance of returns to land as a determinant of farmland prices, they disagree about the role of interest rates and inflation. Analysis of farmland prices for the conterminous United States, the Corn Belt, and wheat-growing areas of Kansas showed that the real interest rate on farm mortgages had only a minimal and temporary effect on farmland prices before 1972. The real interest rate along with returns have become major determinants of farmland prices since then. Changes in the inflation rate will affect real farmland prices if nominal interest rates fail to keep up with inflation.*

Keywords. *Land prices, land returns, interest rates, distributed lag, rational lag*

Legislative proposals for agriculture raise persistent questions about the effect of initiatives on farmland prices. A large number of national and regional studies conclude that returns to land are a principal determinant of farmland prices (*1,3,15,16,18,19*).[1] Projecting farmland prices solely from returns, however, ignores other possible influences. Both the popular press and agricultural economics literature stress the rate of interest charged on farm real estate loans and the rate of inflation. A widely held view is that high interest rates hurt farmland prices while inflation tends to raise real farmland prices. Theory supports this view. Any asset that provides a stream of returns over time will decline in value if future payments are more highly discounted. A number of theoretical studies conclude that if both returns and interest rise by the amount of the increase in the inflation rate, real land prices will climb (*1,4,18*). This rise occurs because the increase in the nominal interest rate is immediately tax deductible, while the tax on the nominal increase in land price is deferred.

Despite what theory would suggest, many econometric studies have failed to establish a strong link between inflation and real farmland prices (*1,2,14,18*). Burt's findings for Illinois cropland support the view that farmland market participants are not influenced by fluctuations in interest rates but discount expected future returns by a constant equilibrium interest rate (*2*). Other studies come to opposite conclusions about the effect of inflation and interest on farmland prices (*7,9,28*). In short, there is no consensus about the effect of inflation and interest rates on farmland prices. The decisions of farmland owners, buyers and sellers of farmland, and policymakers would be improved if economists could provide them with valid information on the relationship between interest rates, inflation, and farmland prices.

This paper shows the effect of real- or inflation-adjusted interest rates on farmland prices. Results are given for the conterminous United States, the Corn Belt, and wheat areas of Kansas. Regional and national analyses augment the number of observations available for the 1970's and 1980's. The homogeneous land use pattern in the selected regions permits enlargement of the sample size by designating subregions and pooling subregional data with time series. The findings are that the real interest rate on farmland mortgages had little or no effect on land prices prior to 1972. Real interest rates had a major effect on the decline of farmland prices in the 1980's. The rates probably influenced the rise of farmland prices in the 1970's, and are likely to continue to be important in the near future. The effect of inflation on farmland prices is not examined directly, but this effect depends mainly on the relative adjustment to inflation of expected returns to land and interest rates. The behavior of real interest rates during inflationary and deflationary periods, when combined with the findings of the effect of real interest rates on farmland prices, leads to the conclusion that the decline of the rate of inflation in the 1980's had a negative effect on real farmland prices, while the rise of inflation in the 1970's probably had a positive effect. Future changes of the inflation rate are likely to continue to affect real farmland prices if nominal interest rates do not fully adjust to inflation.

The Model

The effect of change in the rate of inflation on farmland prices depends principally on land investors' expectations of the impact of inflation on farmland returns and interest rates. If inflation is expected to have the same impact on land returns and interest rates, then except for possible income tax effects, there will be no immediate effect, although over time nominal farmland prices will change at a rate equal to the inflation rate.

To derive the above conclusion, assume constant real returns equal to X and a constant real interest rate R

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[1] Italicized numbers in parentheses cite sources listed in the References section at the end of this article.

and zero inflation The price of land, P, is given by the traditional capitalization formula P = X/R Now introduce inflation at an annual rate I and assume that land investors expect both returns and the interest rate to fully adjust to inflation The price of land will be equal to

$$P = \frac{X(1+I)}{(1+R)(1+I)} + \frac{X(1+I)^2}{(1+R)^2(1+I)^2} + \frac{X(1+I)^3}{(1+R)^3(1+I)^3} + \quad (1)$$

The common factor (1+I) cancels out, and the equation is a geometric progression that sums to the traditional capitalization formula P = X/R Inflation is not neutral if land investors expect inflation to affect returns and interest rates differently Suppose investors expect nominal returns to land to change by $(1+I_x)$ annually, while nominal interest rates are expected to change by $(1+I_r)$ Then

$$P = \frac{X(1+I_x)}{(1+R)(1+I_r)} + \frac{X(1+I_x)^2}{(1+R)^2(1+I_r)^2} + \frac{X(1+I_x)^3}{(1+R)^3(1+I_r)^3} + \quad (2)$$

The inflation factor no longer cancels out and equation 2a sums to

$$P = \frac{X(1+I_x)}{R(1+I_r) + I_r - I_x} \quad (3)$$

If $I_x > I_r$, the numerator in equation 3 will increase by more than the denominator, resulting in a one-time jump in farmland prices If $I_r > I_x$, there will be a one-time decline Thereafter, in both cases, nominal farmland prices will change at the rate of I_x, the expected impact of inflation on returns to land

No studies exist on the effect of inflation on land returns [2] Sundell concludes, however, that the adjustment of interest rates to inflation is likely to lag and be insufficient to prevent longrun impacts on real interest rates (*23*) Thus, the effect of a change in the inflation rate on farmland prices depends on whether current changes in the real interest rate due to lagging adjustment of interest rates to inflation are incorporated in the capitalization rate employed by farmland investors

The estimating equation is designed to distinguish between three alternative hypotheses of how land investors react to a change in real interest rates

$$H_1 = P_t = \frac{X^*_t}{R} \quad (4)$$

$$H_2 = P_t = \frac{X^*_t}{R_t} \quad (5)$$

$$H_3 = P_t = \frac{X^*_t}{R^*_t}, \quad (6)$$

where P_t is price per acre at the beginning of the year

X^*_t is the level of future returns expected in year t Returns are estimated in real terms at the price level prevailing at the beginning of year t R is the real interest rate, and its various designations follow

Hypothesis 1 (H_1) states that land investors capitalize returns by a fixed long-term equilibrium real rate of interest R and are not influenced by current real rates

Hypothesis 2 (H_2) is the opposite of hypothesis 1 and postulates that investors capitalize returns by the current real rate of interest R_t

Hypothesis 3 (H_3) holds that land investors capitalize returns by neither a fixed long-term rate nor a current rate but an expected real rate of interest R^*_t which is not constant

A single estimating equation allows us to test the three hypotheses simultaneously The tests are based on the expected values of the regression coefficients and of the constant term, which assume different values for the three hypotheses The equation is derived from a distributed lag model in which expected returns are a weighted mean of past returns

Burt developed the equation for a fixed capitalization rate, which is adapted here to accommodate variable interest rates The derivation of the estimating equation is not given here to conserve space [3] The logic of the equation and the expected values of the coefficients are explained here The estimating equation is

$$\text{Log } P_t = \text{Log } B_0 + B_1 \text{ Log } X_t + B_2 \text{ Log } X_{t-1} + B_3 \text{ Log } P_{t-1} + B_4 \text{ Log } P_{t-2} + B_5 \text{ Log } R_t + B_6 \text{ Log } R_{t-1} + B_7 \text{ Log } R_{t-2} + e_t, \quad (7)$$

where
P_t is price per acre in the current year,
X_t, X_{t-1} are returns per acre current and lagged,

[2] Tweeten wrote that inflation lowered the parity ratio in 1948-77 (*24*) However, his conclusion is based primarily on domestic demand for farm products For 1967-78, Schluter and Lee come to the opposite conclusion (*21*) Gardner found no significant effect of inflation on real farm income during 1956-78, but he separated inflation from the variation of exchange rates (*5*)

[3] Derivation of the equation and of the expected values of the coefficients is available in Karl Gertel and Patrick Canning *Returns, Interest Rates, and Cropland Prices in Selected Regions* TB-1778 U S Dept Agr , Econ Res Serv , May 1990

P_{t-1}, P_{t-2} are price per acre lagged by 1 and 2 years,
R_t, R_{t-1}, R_{t-2} are real interest rates, current and lagged by 1 and 2 years, and
e_t is the stochastic error term

Equation 7's price per acre in the current year is a weighted geometric mean of the capitalized returns in the current and preceding years and land prices in the preceding 2 years According to the traditional capitalization formula, an increase in returns will result in a proportionally equal increase in the price of land, that is, the elasticity of land price with respect to returns is 1 The coefficients B_1, B_2, B_3, and B_4 are proxies for expected returns Therefore the expected value of the sum $B_1 + B_2 + B_3 + B_4 = 1$ This equality holds for all alternative hypotheses

If hypothesis 1 is true, the coefficients for interest rates B_5, B_6, and B_7 have an expected value of zero, since land investors capitalize expected returns by a long-term equilibrium rate of interest which is embedded in the constant term B_0, and are not influenced by current rates The constant term represents the inverse of the capitalization rate, carrying an expected positive value

The rationale of the estimating equation under hypothesis 1 can be seen by converting equation 1 from log form to an exponential form With the interest coefficients set at zero and the stochastic error term omitted, equation 7 is transformed into the exponential form

$$P_t = B_0 \overline{X}^{(B_1 + B_2)} P_{t-1}^{B_3} P_{t-2}^{B_4} \qquad (8)$$

where $\overline{X}$ is the weighted geometric mean of X_t and X_{t-1}

Equation 8 says that price per acre is a geometric mean of 1) the average of returns for the current and preceding years, multiplied by a constant which is the inverse of the capitalization rate, and 2) price per acre in the preceding 2 years [4]

If hypothesis 2 is true, the expected value of the coefficient for the current interest rate is -1 because the elasticity of land price with respect to the current interest rate is -1

The expected values of the coefficient of R_{t-1} is equal to the coefficient of P_{t-1}, and the expected value of the coefficient of R_{t-2} is equal to the coefficient of P_{t-2} since lagged interest rates are used to convert lagged land prices to an implict annual return With variable interest rates, no constant term exists, so the expected value of B_0 is 1

When $B_0 = 1$, $B_6 = B_3$, $B_7 = B_4$, and $B_5 = -1$, the estimating equation becomes

$$P_t = \overline{X}^{(B_1 + B_2)} (P_{t-1} R_{t-1})^{B_3} (P_{t-2} R_{t-2})^{B_4} R_t^{-1} \qquad (9)$$

In equation 9, the annual returns that are implicit in the lagged land prices come from multiplying lagged land prices by lagged interest rates The geometric mean of current and lagged returns is then capitalized by dividing by the current interest rate

If hypothesis 3 is true, expected returns and expected interest rates have equal but opposite effects on land prices Therefore, the expected value of the sum of the interest rate coefficients is equal but opposite in sign to the sum of the coefficients for returns to land When $(B_5 + B_6 + B_7) = -(B_1 + B_2,)$, the estimating equation is

$$P_t = \overline{X}^{(B_1 + B_2)} \overline{R}^{-(B_1 + B_2)} P_{t-1}^{B_3} P_{t-2}^{B_4}, \qquad (10)$$

where $\overline{R}$ is the weighted mean of R_t, R_{t-1}, and R_{t-2}

Equation 10 gives price per acre as the geometric mean of 1) average returns capitalized by the average interest rate, and 2) price per acre in the preceding 2 years

Table 1 summarizes the expected values of intercept and coefficients for the three alternative hypotheses

Intercorrelation between the error terms of unexplained residuals is a frequent problem with such equations as 7 in which past land prices are used to explain current prices A strong interrelationship among successive error terms may result in estimates that do not converge to a fixed level as they are computed from successively larger samples Corrective procedures through modeling of error terms is likely to be unsatisfactory and extremely complex, especially with pooled cross-section time period samples over a short time period (*2*) First tested was serial correlation between two successive error terms (Durbin h test) If no significant relationship between two successive terms was found, a test was made for a significant relationship among three successive error terms (Breusch-Godfrey test) Where a significant interrelationship between successive error terms was found, some indication of the effect on the estimates was

[4]Assumption empirically all coefficients in equation 8 are positive The coefficient of P_{t-2} was sometimes found to be negative In such cases, the interpretation is in terms of ratios For example, this year's land price P_t, is the previous year s land price adjusted by the ratios P_{t-1}/P_{t-2} For a fuller explanation, see (*2*, p 22)

Table 1—Expected coefficients under alternative hypotheses

Coefficients and equalities	Investors capitalize expected returns by		
	Fixed rate of interest (H_1)	Current rate of interest (H_2)	Expected rate of interest (H_3)
Intercept ($LogB_0$)	Positive	Zero	Zero
$B_1 + B_2 + B_3 + B_4$[1]	1	1	1
Current real interest (B_5)	Zero	−1	negative absolute value < 1
Equalities	$B_5 = B_6 = B_7 = 0$	$B_6 = B_4$[2] $B_7 = B_4$[2]	$-(B_5 + B_6 + B_7) = B_3 + B_4$[3]

[1]Sum of coefficient of current and lagged returns and lagged land prices

[2]Lagged interest coefficients are equal to lagged land price coefficients for the same year

[3]Sum of coefficients of current and lagged interest rates equal the negative of the sum of the coefficient for current and lagged returns to land

obtained by comparing the estimates with those resulting from a procedure which corrects for correlation between two successive variables In the case of the Corn Belt, it was also possible to develop an alternative model to compare the coefficients for interest rates with those obtained from equation 7

Procedures and Sources of Data

The areas studied are land in farms in the conterminous United States and two regions selected because land use is homogeneous and nonfarm influences on land prices are relatively minor The first region selected was the Corn Belt—Illinois, Iowa, Indiana, and Ohio—where corn and soybeans accounted for approximately 64 percent of all land in farms in 1982 Missouri normally included in the Corn Belt, was excluded because just 24 percent of land in farms was harvested for corn or soybeans in 1982 The second region is the cropland area of Crop Reporting Districts (CRD's) 20, 40, and 50, in central and western Kansas (the Kansas wheat region) comprising some 6 5 million acres of harvested cropland with about 65 percent dryland wheat in 1982, heterogeneity of land use precluded using the entire State for the analysis

Returns to Farmland

I adopted the frequent practice of using returns to farm assets as a proxy for returns to farmland (*15,19 20*) The ERS series of returns to assets (*26*) was adjusted to exclude five Standard Industrial Classes of Farms (Animal Specialty, Fruits and Nuts, Horticulture, Poultry and Eggs, and Vegetables), which accounted for approximately 25 percent of total gross receipts in 1982 but only 3 percent of land in farms (*22*) Regional returns were calculated as the weighted mean of returns per acre, including Government payments, for the principal crops (*27*) Since average returns reflect a wide range of positive and negative returns (*8 10*) and most farmland is purchased to expand existing farms (*25*, p 20), farmland prices are likely to be more closely related to returns to expansion buyers than to average returns Therefore, the returns series was modified to reflect returns to expansion buyers by including only half the overhead and depreciation costs

Farmland Prices

National and regional series of returns per acre were matched with appropriate series of price per acre For the conterminous United States, the appropriate series was U S average value per acre of land and buildings The same land price series was employed for the Corn Belt since 64 percent of land in farms in 1982 was harvested for corn and soybeans Different series had to be matched with returns to dryland wheat for the Kansas wheat region since just 39 percent of the land in farms was harvested for dryland wheat The series most closely representing dryland wheat was the plowland series, available through 1975, and the nonirrigated cropland series thereafter

The Real Interest Rate

The real interest rate on farm real estate mortgages was taken as the average interest rate charged by the Federal Land Banks on new farm real estate loans less the rate of inflation measured by the GNP deflator During the period covered by the analysis, Federal Land Banks were the principal lender of farm real estate loans (*25*)

Estimates presented in the following section are based on nominal land prices and nominal land returns This is the appropriate procedure since derivation of equation 7 comes from equation 1 in which the effect of future inflation on expected returns and interest rates cancel out [5] The analysis was carried out in deflated terms with similar results for most of the results presented

Conterminous United States

Table 2 relates average U S price per acre to land returns, past farmland prices, and interest rates The period 1942-72 ended just before the sharp run-up in the 1970's The period 1942-87 helps detect changes in the coefficient because of structural change The Durbin h test detected significant autocorrelation of residuals for 1942-72 Therefore, the robustness of the

[5]Tweeten developed a similar equation for an economy in which land earnings and land returns change with the inflation rate (*17*)

Table 2—U S average price per acre related to the real rate of interest on farm mortgages, returns to assets per acre, and past land prices[1]

Coefficients	1942-72		1942-87
	OLS[2]	CO[1]	OLS[2]
Constant	0 0882	0 0867	−0 0105
	(0730)[1]	(1086)	(0520)
Real interest rate	− 0217	− 0258	− 0312
	(0134)	(0133)	(0147)
Real interest rate, 1 year ago	− 0268	− 0283	− 0269
	(0125)	(0134)	(0151)
Real interest rate, 2 years ago	0475	0426	0178
	(0128)	(0144)	(0147)
Returns to assets	− 0064	− 0126	0069
	(0191)	(0217)	(0245)
Returns to assets 1 year ago	0338	04936	0227
	(0202)	(01956)	(0230)
Price of cropland, 1 year ago	1 4007	1 2269	1 4996
	(1403)	(1693)	(1374)
Price of cropland 2 years ago	− 4470	− 2816	− 5307
	(1410)	(1646)	(1394)
Number of observations	31	31	46
Adjusted R^2	9877	9976	9985
Standard error of regression	0109	0103	0178
Durbin h	2 8123	1 6915	− 5116
Sum of coefficients relating to returns	9811	9821	9981

[1]All variables in logs base 10
[2]Ordinary least squares
Cochran-Orcutt procedure to correct for first-order autocorrelation of residual
[1]Numbers in parentheses are standard errors

results was examined by comparing the coefficients obtained from ordinary least squares with the coefficients obtained from the Cochran-Orcutt procedure which corrects for first-order autocorrelation of residuals The coefficients obtained from the two procedures are similar in signs and magnitude For 1942-87, the Breusch-Godfrey test indicated no first or second order of autocorrelation of the residuals So, table 2 shows only the results for ordinary least squares (OLS)

For both 1942-72 and 1942-87, the results tend to support hypothesis 3, that land investors capitalize returns by an expected real interest rate Under hypothesis 1, the constant term relates to the inverse of the capitalization rate and has an expected positive value The constant terms in table 2, by contrast, generally fall below their standard errors The coefficients for the current interest rate have the expected negative values but are well below 1 in absolute value, which would be expected if land investors capitalized returns by the current real interest rate, as stipulated by hypothesis 2 During 1942-72, the coefficient for a change of the real interest rate is negative and small for the current year and for the following year, and of the same general magnitude as the coefficients for returns as would be expected under hypothesis 3, which attaches equal importance to interest rates and returns However, these small negative effects of rising real interest rates are almost precisely canceled out by a positive coefficient in the third year What this result suggests is that any effects of changing real interest rates were small and temporary, a reasonable outcome for 1942-72 Although real interest rates turned negative after World War II when double-digit inflation followed the termination of wartime economic controls, the trend for 1942-72 increased by 0 07 percentage point per year, an amount hardly detectable by farmland investors

The negative coefficients for interest rates in current and preceding years are not offset by the much smaller positive coefficient in the third year for 1942-87 This result suggests a structural change after 1972 in which land market participants became more responsive to a change in the real interest rate, a plausible result From 1973 to 1981, the real interest rate averaged 1 2 percent compared with 3 1 percent in the previous decade The real interest rate rose to 7 9 percent from 1982 to 1987

Compared with the coefficients obtained by Burt for Illinois grainland, the U S coefficients for returns for 1942-87 were low (*2*), suggesting possible problems with aggregating returns across diverse regions, including areas where nonfarm influences on land are important The lower coefficient for returns for 1942-87 compared with 1942-72 is consistent with the highly variable, but generally favorable, levels of farm income in returns to farm assets during the 1980's (*13*)

The Corn Belt

Two periods are examined, 1972-86 and 1972-81 (table 3) In the 1972-81 subperiod, real interest rates were generally falling and farmland prices rising Since the Durbin h test indicates significant autocorrelation of the residuals, results are also shown for the Cochran-Orcutt procedure which corrects for first-order autocorrelation Results are also given for an alternative model in which land prices are related to average returns in the 5 preceding years and the real interest rate, current and lagged by 2 years The 1-year lag was excluded in the alternative model because in nearly all regional work, the coefficient for the interest rate lagged by 1 year was not significant

The regressions for 1972-86 showed a strong negative relationship between land prices and the real interest rate on Federal Land Bank real estate loans The moving average model produced similar results for 1975-87 The sum of the coefficients for interest rates is of the same absolute order of magnitude as the sum of the coefficients for returns, supporting hypothesis 3 For 1972-82 regressions, which are based on equation 7, the coefficients for the real interest rates are

Table 3—Corn Belt cropland, average price per acre related to the real rate of interest on farm mortgages, returns to assets per acre and past land prices[1]

Coefficients	1972-86		1975-87	1972-81		1975-81
	OLS[2]	CO[3]	CO[3]	OLS[2]	CO[3]	CO[3]
Constant	−0.0133	−0.0730	0.5907	−0.1094	−0.0376	−1.0249
	(.0966)[4]	(.0769)	(.3457)	(.1124)	(.1023)	(.3467)
Real interest rates	−.0798	−.0809	−.0823	.0508	−.0096	−.1538
	(.0235)	(.0197)	(.0263)	(.0515)	(.0404)	(.0600)
Real interest rate 1 year ago	.0244	.0646		.0247	.0302	
	(.0250)	(.0225)		(.0300)	(.0237)	
Real interest rate, 2 years ago	−.0974	−.0941	−.1288	.0120	−.0351	−.1495
	(.0216)	(.0190)	(.0261)	(.0495)	(.0379)	(.0567)
Returns to land	.0034	.0723		.0930	.0419	
	(.0487)	(.0393)		(.0495)	(.0379)	
Returns to land, 1 years ago	.1515	.0984	1.0919[5]	.2210	.1678	1.7888[5]
	(.0340)	(.0299)	(.1476)	(.0597)	(.0498)	(.1292)
Price of land 1 year ago	.9666	1.2784		.9103	.5283	
	(.1122)	(.0982)		(.1534)	(.1472)	
Price of land 2 years ago	−.1390	−.4234		−.0185	.3338	
	(.1101)	(.0941)		(.1503)	(.1494)	
Number of observations	60	60	52	40	40	28
Adjusted R^2	.9790	.9815	.8720	.9825	.9845	.8961
Standard error of regression	.0299	.0276	.0497	.0302	.0282	.00470
Durbin h	2.3607	−1.3160	1.2840[6]	5.4764	.4550	1.6594[6]
Sum of coefficients relating to returns	.9825	1.0257	1.0919	1.2060	1.0718	1.7888

[1]Comprised of Illinois, Indiana, Iowa, and Ohio. All variables in logs base 10.
[2]Ordinary least squares.
[3]Cochran-Orcutt procedure to correct for first-order autocorrelation of residual.
[4]Numbers in parentheses are standard errors.
[5]Average of 5 preceding years.
[6]Durbin-Watson statistic.

small in relation to their standard error, indicating no effect of interest rates in this period. By contrast, the moving average model results in a negative coefficient for the real interest rate of approximately the same magnitude as for 1972-86. Thus, for subperiod 1972-81, the results are unclear, but a negative effect of real interest rates on farmland prices cannot be ruled out.

The sum of current and lagged coefficients for the real interest rate is −0.15 for the OLS regression and −0.11 for the Cochran-Orcutt procedure for 1972-86. Since the coefficients of an exponential equation are elasticities, the results indicate that a 1-percent rise in real interest on farm mortgages would result in a decline of land prices of 0.11 to 0.15 percent. Thus, a 25-percent increase in the interest rate, say from 4 to 5 percent, would cause land prices to fall by 25 times 0.11 to 25 times 0.15 or approximately 3 to 4 percent. From 1981 to 1983, the real interest rate rose by almost 400 percent, which would result in an estimated fall of farmland prices of 400 times 0.11 to 400 times 0.15, or 44 to 60 percent. These numbers suggest that the rise in real interest rates was a major contributor to the decline of Corn Belt farmland prices in the 1980's.

Kansas Wheat Region

The Breusch-Godfrey test showed no significant second-order autocorrelation between residuals for 1972-86, but a second-order autocorrelation was found for 1972-81 in the Kansas wheat region (table 4). To examine the robustness of the 1972-81 coefficients, results for ordinary least squares are shown with results from the correction for first-order autocorrelation using the Cochran-Orcutt procedure. The coefficients for interest rates and returns are similar for both procedures.

A strong negative relationship existed between the real interest rate on farm mortgages and cropland prices for 1972-86. The coefficients for the 1972-81 subperiod are quite similar, suggesting that cropland prices responded to the decline of real interest rates in the 1970's and their rise in the 1980's. A dynamic pattern of response to interest rates was similar to the pattern in 1972 in the Corn Belt. The negative response to a rise in real interest rates occurs in the year in which the rates go up. There is a little response or a small recovery in the following year and a further decline 2 years after the rise in rates occurred. The reason for this pattern is unclear. Possibly the initial response in the first year is followed by a period of adjustment and of waiting for confirmation of the new real rate and a further response, as the new rate continues into the third year.

As was found for the Corn Belt, land prices respond much more to returns earned in the previous year than returns anticipated for the current year. Since USDA obtains land prices for the first quarter of the year

Table 4—Kansas wheat region cropland, average price per acre related to returns to the real rate of interest on farm mortgages, returns to assets per acre, and past land prices[1]

Coefficients	1972-86 OLS[2]	1972-81 OLS[2]	1972-81 CO[3]
Constant	−0 2291	−0 1924	−0 1177
	(1239)[4]	(1379)	(1851)
Real interest rate	− 0929	− 1174	− 1440
	(0308)	(0674)	(0656)
Real interest rate, 1 year ago	0229	0547	0503
	(0370)	(0449)	(0414)
Real interest rate, 2 years ago	− 1491	− 1545	− 1840
	(0328)	(0599)	(0539)
Returns to land	0443	0215	0032
	(0352)	(0515)	(0519)
Returns to land, 1 year ago	1125	1517	1561
	(0346)	(0425)	(0500)
Price of land, 1 year ago	7066	5333	3048
	(1461)	(1992)	(1877)
Price of land, 2 years ago	1522	3046	4737
	(1402)	(1707)	(1563)
Number of observations	43	29	29
Adjusted R^2	9625	9662	9621
Standard error of regression	0365	0373	0364
Durbin h	− 9115	(5)	− 3150
Sum of coefficients relative to returns	1 0156	1 0111	9371

[1]Kansas Crop Reporting Districts 20 40, and 50 All variables in logs base 10
[2]Ordinary least squares
[3]Cochran-Orcutt procedure to correct for first-order autocorrelation of residuals
[4]Numbers in parentheses are standard errors
[5]Calculations of Durbin h not feasible because they result in negative square roots

while returns accumulate throughout the year, this finding is consistent with the hypothesis that land market participants form expectations primarily from past returns rather than anticipated future returns This hypothesis is consistent with the limited success of the application of rational expectations to farmland prices reported by Just and Miranowski (*12*)

Conclusions

The decisions of farmland investors and policymakers would probably improve with information on the relationship between interest rates, inflation, and farmland prices Changes in the real interest rate had only a small and temporary effect on farmland prices during 1942-72 but were significant thereafter for the conterminous United States Results from the Kansas wheat region showed that the decline in the real interest rate contributed to rising farmland prices during the 1970's All three regions pointed to a rise in the real interest rate as a major contributor to the decline of farmland prices in the 1980's

The effect of inflation on farmland prices was not investigated directly, but theory tells us that the impact of inflation on farmland prices depends mainly on the relative adjustment of land returns and real interest rates to the changed rate of inflation A change in the real interest rate will likely produce an opposite change in farmland prices in the near future, judging by the response to changing real interest in recent decades

The relationship between returns and land prices at the national level was weaker than at the regional level, reflecting problems of aggregating returns over diverse regions including areas where nonfarm influences were important The response of farmland prices to a change in returns was similar and resulted in a lagged adjustment of farmland prices in the Corn Belt and the Kansas wheat region During 1972-86, approximately 10-15 percent of the change in returns in the preceding year and 0-7 percent of the change in the current year was reflected in current land prices

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