Dynamics of Farm Interest Rates

Allen M. Featherstone, Barry K. Goodwin, and Alan D. Barkema

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Department of Agricultural, Resource and Managerial Economics
College of Agricultural and Life Sciences
Cornell University, Ithaca, New York 14853

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DYNAMICS OF FARM INTEREST RATES

Allen M. Featherstone, Barry K. Goodwin, and *Alan D. Barkema*[1]

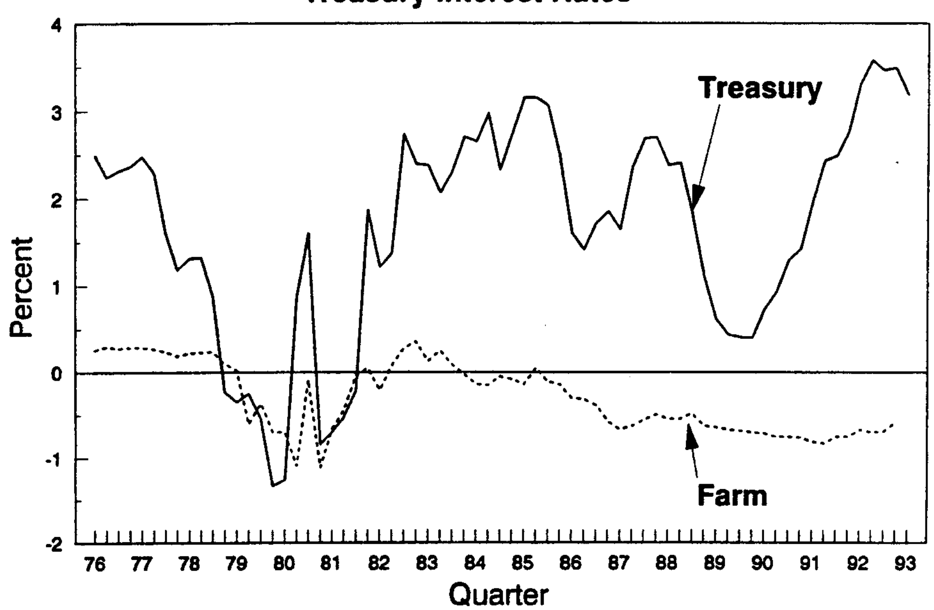
A concern of many U.S. farmers in recent years is that interest rates on farm loans have declined less than short-term interest rates in the national money market. Interest rates on farm loans and in the national money market have generally declined during the early 1990s. During that period, however, short-term rates in the money market have fallen nearly twice as much as farm interest rates.

The four sections of this paper explore the relationship between interest rates in the national money market and interest rates on farm loans. The first section introduces the problem in greater detail. The second section reviews the theoretical concepts which underlie the relationships among various interest rates. The third section describes the empirical methods and data used in the analysis. The fourth section presents the results of the analysis.

Introduction

Interest rates in the U.S. money market have generally declined since early in 1989, but short-term rates fell much more than long-term rates. For example, the yield on six-month Treasury bills fell much more than twice as much (a decline of 621 basis points) as the yield on 10-year Treasury bonds (a decline of only 269 basis points) from March 1989 to December 1992. As a result, the "Treasury spread" (the difference between the yields on the six month T-bill and the 10-year T-bond) widened markedly (Figure 1).

Figure 1. Quarterly Spreads for Farm Lending Treasury Interest Rates



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[1] Allen M. Featherstone is an associate professor in the Department of Agricultural Economics at Kansas State University, Barry K. Goodwin is an associate professor in the Department of Agricultural Economics at North Carolina State University, and Alan D. Barkema is a senior economist at the Federal Reserve Bank of Kansas City.

Interest rates on farm loans in the Tenth (Kansas City) Federal Reserve District also declined sharply during this four-year period, but they did not follow money market rates in lock step. Short-term farm interest rates fell much less than short-term money market rates while long-term farm interest rates fell slightly more than long-term money market rates. For example, the average rate charged on farm operating loans, which usually have a term of less than a year, fell 316 basis points--about half the decline in the six-month T-bill yield, much to the dismay of district farmers. Meanwhile, the average rate on farm real estate loans fell 311 basis points, about 50 basis points more than the decline in the 10-year bond yield, a fact which should lend some comfort to farm borrowers. Thus, the farm interest rates fell almost uniformly, regardless of the term of the loan leaving the "farm spread" (the difference between interest rates on farm real estate loans and on farm operating loans) at about zero, in sharp contrast to the marked widening of the Treasury yield spread (Figure 1).

In contrast to the striking difference in the behavior of farm and money market interest rates in recent years, earlier data point to a closer relationship between the two. For example, the correlation between the farm spread and the Treasury spread from 1976 to 1984 is 74 percent. But after 1984, the correlation drops to only 37 percent. These trends in farm and Treasury interest rates points to the central question of this paper: what relationship exists between farm interest rates and interest rates in the national money market, and how has that relationship changed in recent years?

Theory

The relationship between short- and long-term interest rates is central to the relationship between farm and money market rates. Economists have developed several theories over the decades to explain the term structure of interest rates. These theories include the expectations theory (Fisher; Lutz; and Meiselman), the market segmentation theory (Culbertson, Roll), and the liquidity preference theory (Hicks). The expectations theory of interest suggest that long-term rates are a function of current and expected short-term rates. Thus, when the spread between long-term rates and short-term rates moves, the market's forecast of the future interest rate path has changed. The market segmentation theory of interest is based on the assumption that securities of different maturities are imperfect substitutes for each other. The liquidity preference theory is based upon the risk aversion of the market participants.

Current economic thought suggests an expectations theory which combines elements of the original expectations theory and the liquidity preference theory (Mankiw; Russell). The "normal" shape of the yield curve is upward sloping. The traditional expectations theory would suggest a flat yield curve on average. Factors which have been used to explain the slope of the yield curve include risk of unanticipated changes in interest caused by factors such as unanticipated inflation. The unanticipated inflation can place the security holder at risk of a capital loss. Thus, the security holder will demand a premium to hold longer term securities instead of shorter term securities. This premium is referred to as a term premium.

Economic theory suggests that the term structure of interest rates in national money markets should be closely related to the term structure of farm interest rates. Profit seeking activity of arbitragers who can borrow (or lend) in both the national money market and the farm loan market would maintain a steady relationship between money market and farm interest rates. But that relationship could change through time with changes in the relative riskiness of borrowing or lending in either market (default risk), changes in the relative costs of loan origination (transactions cost), and shifts in demand for credit in the farm sector and in other sectors of the economy.

Other researchers have recently focused attention on the relationship between the national money market rates and farm interest rates. Babula, Duncan, and Vasavada found that farm interest rates tend to be somewhat "sticky" in responding to changes in the 3-month T-bills. Covey and Babula that a one-to-one relationship between changes in nominal farm interest rates and expected inflation (the Fisher relationship) does not exist. Duncan and Singer found that the yield spread between Treasury and Farm Credit System securities widened when the Farm Credit System fell on hard times in the mid-1980s and then narrowed as the System recovered.

The work described herein is unique from these previous efforts in two respects. First, this study uses cointegration analysis to determine the dynamic long-run stability of farm and money market interest rates. Second, the study uses impulse analysis to determine the dynamic response if farm interest rates to changes in money market rates.

Procedures and Methods

The previous discussion of theory would suggested that farm lending rates and macroeconomic rates should have some stable long-run equilibrium. Multivariate cointegration tests have been recently introduced by Johansen; Engle and Granger; and Johansen and Juselius to examine long-run equilibrium relationships. These have been widely applied in the agricultural economics literature (Goodwin and Schroeder; Goodwin).

Bivariate and Multivariate Cointegration Tests

Cointegration tests are a means for evaluating the long-run stability of economic equilibrium conditions. These tests evaluate the long-run stability of linear combinations of two or more variables which are, when taken alone, nonstationary. If a linear combination of two or more nonstationary variables can be used to form a stable equilibrium, the variables are said to be cointegrated. Widespread recognition of the fact that many economic time series are nonstationary has led to increasingly frequent use of cointegration testing techniques.

A number of different approaches to evaluating cointegration relationships have been developed. For bivariate comparisons, Engle and Granger offer a number of different tests. Of their tests, the augmented Dickey Fuller test is the most powerful over a wide range of empirical circumstances and has realized the greatest use. The augmented Dickey Fuller test considers the stationarity of the residuals e_t from the following regression:

$$y_t = \alpha + \beta x_t + e_t \tag{1}$$

where y_t and x_t are the two nonstationary variables being considered. These residuals are estimated in a first stage and then the following Dickey-Fuller stationarity test is applied:

$$\Delta e_t = -\phi e_{t-1} + \theta_1 \Delta e_{t-1} + \ldots + \theta_p \Delta e_{t-p} + \varepsilon_t \tag{2}$$

The augmented Dickey-Fuller test is given by the ratio of $-\phi$ to its standard error. If the test statistic exceeds the relevant critical value tabulated by Engle and Granger, the null hypothesis of no cointegration is rejected.

More recent work by Johansen and Juselius has developed tests for examining cointegration relationships among several variables.[2] Under Johansen and Juselius' multivariate approach, a fully-specified vector error correction model of the form:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \mu + e_t \tag{3}$$

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[2] Johansen and Juselius offer critical values for cointegration tests for up to five variables. Osterwald-Lenum extended Johansen and Juselius' tests to include critical values for testing cointegration in groups of up to 11 variables.

is estimated using maximum likelihood procedures. Note that Y_t is a pxT dimensional matrix of data, $(\Gamma_1, ..., \Gamma_{k-1}, \Pi, \mu)$ are parameters to be estimated, and e_t is a random error term. Inferences regarding the number of cointegrating vectors that exist among the p variables are drawn from a consideration of the rank of the Π matrix. If the rank of the Π matrix is greater than zero (but less than p), a cointegration relationship among the variables is implied. Specifically, if the rank of Π is r, then there are r unique cointegrating vectors among the p variables.

Johansen developed two tests for evaluating the number of cointegrating vectors that exist among a set of time series variables. Under Johansen's approach, the following vector autoregressive models are estimated:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{k-1} \Delta Y_{t-k+1} + v_t \qquad (4)$$

$$Y_{t-k} = \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{k-1} \Delta Y_{t-k+1} + u_t$$

The residual vectors v_t and u_t are then used to construct two likelihood ratio test statistics that can be used to determine the number of cointegrating vectors. The first test statistic, known as the trace test, evaluates the null hypothesis that there are at most r cointegrating vectors and is given by:

$$\tau_{trace} = -T \Sigma_{i=r+1}^{p} \ln(1-\lambda_i) \qquad (5)$$

where $\lambda_{r+1}, ..., \lambda_p$ denotes the p-r smallest squared canonical correlations of v_t with respect to u_t. The second test is known as the maximal eigenvalue test. This test evaluates the null hypothesis that there are exactly r cointegrating vectors in Y_t and is given by:

$$\tau_{max} = -T \ln(1-\lambda_i) \qquad (6)$$

Each test has, as its alternative, the case of $g > r$ cointegrating vectors.

Impulse Responses for Cointegrated Systems

In applied time series analysis, it is often of interest to consider the time path responses of variables to exogenous shocks to any one of the variables in the system. Such time path responses yield inferences regarding the dynamic adjustments in each of the variables that occur in response to unexpected shocks. These time path responses are referred to as impulse responses. Calculation of impulse responses for a cointegrated system of variables follows much the same approach as what is used to obtain impulse responses in a standard VAR system. However, the fact that cointegration implies an error correction model alters the usual procedures for calculating and interpreting impulse responses. If the variables are cointegrated, shocks to the system should move the time path of the system to a new equilibrium rather than dying out in the long run. This reflects the error correction properties of cointegrated variables. The error shock brings about a correction to a new equilibrium.

Lütkepohl and Reimers discuss the correct approach to calculating impulse responses from cointegrated systems. Under their approach, the error correction model represented by equation (3) is estimated using maximum likelihood procedures. The following matrix is then constructed from the error correction model's parameter estimates:

$$[A_1, A_2, ..., A_k] = [\Gamma_1, ..., \Gamma_{k-1}, \Pi]D + J \qquad (7)$$

where:

$$D = \begin{bmatrix} I_k & -I_k & 0 & 0 & \dots & 0 \\ 0 & I_k & -I_k & 0 & \dots & 0 \\ . & & & & . & \\ . & & & & -I_k & \\ 0 & \dots & & & I_k & \end{bmatrix} \quad (8)$$

$$J = [I_k\ ,\ 0\ ,\ \dots,\ 0] \quad (9)$$

where I_k is a k dimensional identity matrix. Lütkepohl and Reimers show that the impulse responses are then given by:

$$\Phi_n = \Sigma\Phi_{n-m}A_m \quad (10)$$

These adjustments recognize the fact that an error correction term (in levels) must be collected with like first differences for each variable.

Data

Money market interest rates used in the analysis include the yield on six-month T-bills, ten-year T-bonds, and Federal Land Bank bonds. The quarterly yield on the Farm Credit System (FCS) bonds were calculated from the average of the yield on the Federal Land Bank bonds on the date nearest the fifteenth of the month.

Farm rates used in the analysis are the annual rates charged on farm operating loans, feeder cattle loans, intermediate farm loans, and farm real estate loans in the Tenth (Kansas City) Federal Reserve District[3]. The farm interest rate data are collected quarterly in the Federal Reserve Bank of Kansas City's Agricultural Credit Survey, and reported in the Kansas City Fed's *Regional Economic Digest*. For each type of farm loan, the data are unweighted averages of interest rates charged on new loans at the end of each quarter by a panel of commercial agricultural banks[4]. The survey began in 1976 with a panel of 180 banks, which gradually eroded to 140 banks. In 1987, additional banks were added to the survey panel to boost the number of banks participating in the survey each quarter to about 330, a panel which includes roughly a third of the agricultural banks in each of the Tenth District's seven states (Barkema and Stanley).

Results

Unit Root Tests

Augmented Dickey-Fuller tests were used to determine the number of unit roots that exist in each series. Cointegration tests cannot be done unless each series is non-stationary or has at least one unit root. The first step in the Dickey-Fuller tests is to determine the lag length. We determined the lag length using the Schwartz Bayesian Criteria (Judge, Griffiths, Hill, and Lee p. 245-46). The Schwartz Bayesian criteria is a trade off between additional fit from adding additional parameters and the number of parameters. The minimum of the test statistic is chosen to be the appropriate lag length. Table 1 presents the Schwartz Bayesian test for different lag lengths and the augmented Dickey Fuller tests for at least one unit root for each of the seven interest rate

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3 The Tenth Federal Reserve District includes all or part of seven states: Colorado, Kansas, western Missouri, Nebraska, northern New Mexico, Oklahoma, and Wyoming.

4 The survey defines an agricultural bank as one with at least 25 percent of its loans to farmers.

series. A lag length of three was optimum for the Feeder Cattle and Operating interest series, while a lag length of one was optimal for the other interest rate series. The Dickey-Fuller test statistic is determined by the t-value on the lagged value in a regression consisting of a constant, a lagged value and lagged values of the differences. The critical values for the unit root test are -2.60, -2.93, and -3.58 for the 10, five, and one percent level of significance, respectively (Fuller, p. 373). The results of the Augmented Dickey Fuller tests suggests that the null hypothesis that at least one unit root exists cannot be rejected at the 10, the five, or the one percent level of confidence.

Table 1. Schwartz Bayesian Criteria for Lag Length and the Dickey Fuller Test for at Least One Unit Root

Lag Length	Feeder Cattle	Operating	Inter-mediate	Real Estate	6-Month T-Bill	10-Year T-Bond	FCS Bonds
0							
1	-.36648	-.39018	-.44360*	-.45975*	.14294*	-.72198	-.71327*
2	-.27311	-.29981	-.34747	-.36285	.18082	-.62616	-.62371
3	-.39460*	-.52897*	-.38970	-.44899	.18786	-.58224	-.56318
4	-.29583	-.43584	-.28929	-.35567	.28792	-.48095	-.46829
5	-.29915	-.44650	-.23377	-.26352	.30789	-.39752	-.38534
6	-.19594	-.34523	-.15219	-.18409	.41068	-.29404	-.28116
T-test[a]	-1.9819	-2.1196	-1.3640	-1.1322	-1.4984	-1.5263	-1.5556

[a] No star indicates that the H_o is not rejected. This indicates that there is at least one unit root.

* Indicates the lag length at which the augmented Dickey Fuller test is performed.

After testing for at least one unit root, the second step is to test for whether at least two unit roots exist. The results of the Augmented Dickey Fuller test for at least two unit roots (using the same critical values as in the test for at least one unit root on first differenced data) is rejected at the five percent level of significance for feeder cattle, intermediate, and real estate interest rates (Table 2). The test for at least two unit roots is rejected at the one percent level of significance for interest rates for the 6-month T-bill, the 10-year T-bond, and the FCS bonds. The test for at least two unit roots is rejected at the 10 percent level for operating interest rates. The results of the tests suggest that the data series contain one unit root (are nonstationary). The practical significance of the Dickey Fuller tests is that cointegration tests cannot be performed on data series which have different numbers of unit roots.

<u>Multivariate Cointegration Tests</u>

After determining that the series contain 1 unit root, the next step is to determine the appropriate order for the multivariate VAR. The Schwartz Bayesian criteria is again used to determine the appropriate lag length. The minimum test statistic is chosen to be the appropriate lag length of three lags for the system consisting of 6-month T-bill, 10-year T-bond, FCS bond, feeder cattle, operating, intermediate, and real estate rates.

Johansen's Trace test and the Maximum Eigenvalue test are used to determine the number of cointegrating vectors in the seven interest rate system. The results of the cointegration tests and the critical values are presented in Table 3. The critical values are derived by Osterwald-Lenum. The multivariate cointegration tests suggest that three or more cointegrating vectors exist in the set of the seven interest rates. Zero cointegrating vectors would indicate that a stable long-run solution does not exist among the seven series. Thus, the results confirm that a stable long-run solution exists for the seven interest rates.

Table 2. Schwartz Bayesian Criteria for Lag Length and the Dickey Fuller Test for at Least Two Unit Roots

Lag Length	Feeder Cattle	Operating	Inter-mediate	Real Estate	6-Month T-Bill	10-Year T-Bond	FCS Bonds
0							
1	-.32384	-.35180	-.40019	-.42310	.11688*	-.67055*	-.59467*
2	-.41194*	-.53737*	-.41835*	-.48263*	.14813	-.60332	-.51452
3	-.31881	-.45626	-.31755	-.38289	.23490	-.50735	-.41352
4	-.28189	-.42342	-.23976	-.28134	.28842	-.44062	-.34525
5	-.17807	-.33336	-.13842	-.18256	.37862	-.33448	-.23929
6	-.07445	-.22415	-.04907	-.08443	.42609	-.26068	-.13862
T-test	-3.0337	-2.7715	-3.2719	-3.0791	-6.9026	-5.0292	-4.9550

* Indicates the lag length at which the augmented Dickey Fuller test is performed.

Table 3. Co-Integration Tests for the Seven Variable Kansas City Farm Interest Rate Series

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	83.54*	46.45	228.54*	131.71
1	59.51*	40.30	145.00*	102.14
2	44.48*	34.40	85.49*	76.07
3	20.50	28.14	41.01	53.12
4	10.97	22.00	20.51	34.91
5	9.33	15.67	9.54	19.96
6	0.21	9.24	0.21	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Johansen's multivariate cointegration tests were redone eliminating two of the following interest rate series; the 10-year T-bond, the 6-month T-bill, and the FCS bond rates.
The results of these tests are summarized in Tables 4-6. Table 4 contains the results from the multivariate cointegration test of the 6-month T-bill, feeder cattle, operating, intermediate, and real

estate rates. The results indicate that no cointegrating vector exists for this system of interest rates. A stable long-run equilibrium does not exist for these five interest rates. Table 5 contains the results of Johansen's cointegration tests for the 10-year T-bond, feeder cattle, operating, intermediate, and real estate interest rate series. The results indicate that a stable long-run solution exists for this series of interest rates. In fact, the Eigenvalue test indicates that more than two cointegrating vectors exists for this series of interest rates. Table 6 contains the results from the cointegration test of the FCS bond, feeder cattle, operating, intermediate, and real estate rates. The results indicate that a long run stable solution exists for this series of interest rates with more than one cointegrating vectors existing for this series of interest rates. It appears that the most stable equilibrium exists for the Kansas City interest rates and the 10-year T-bond rate then the FCS bond rate. The 6-month T-bill rates and the Kansas City interest rates do not have a long-run stable equilibrium. An implication of the cointegration results is that shorter maturity macroeconomic rates are not an appropriate interest rates to use as proxies for farm lending rates. In addition, when looking to determine future changes in farm interest rate series it is more appropriate to focus on longer term macroeconomic rates than shorter term rates.

Table 4. **Co-Integration Tests for the Five Variable Kansas City Farm Interest Rate Series (10-Year T-Bonds and FCS Bonds Eliminated)**

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	30.75	34.40	66.93	76.07
1	21.91	28.14	36.18	53.12
2	10.78	22.00	14.27	34.91
3	3.16	15.67	3.49	19.96
4	0.33	9.24	0.33	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Table 5. **Co-Integration Tests for the Five Variable Kansas City Farm Interest Rate Series (6-Month T-Bills and FCS Bonds Eliminated)**

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	66.12*	34.40	117.78*	76.07
1	28.90*	28.14	51.66	53.12
2	13.27	22.00	22.76	34.91
3	8.62	15.67	9.49	19.96
4	0.87	9.24	0.87	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Table 6. Co-Integration Tests for the Five Variable Kansas City Farm Interest Rate Series (6-Month T-Bills and 10-Year T-Bonds eliminated)

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	55.34*	34.40	102.22*	76.07
1	22.80	28.14	56.88	53.12
2	18.36	22.00	24.08	34.91
3	5.11	15.67	5.72	19.96
4	0.61	9.24	0.61	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Bivariate Cointegration Tests

The next step of analysis was to run pairwise cointegration tests for each pair of interest rate series. This resulted in 21 bivariate cointegration tests. Two cointegration tests were examined. The first test was constructed by examining the difference between the two series and then performing an augmented Dickey Fuller test to determine whether the spread had one or more unit roots. If one or more unit roots could not be rejected, then a cointegrating vector is said not to exist. The results indicate that for all of the pairwise comparisons except one, the existence of a unit root could not be rejected. Thus, this would suggest that the series are not pairwise cointegrated. The only two series that were cointegrated using the augmented Dickey Fuller test were the feeder cattle and the operating loan interest rate series. It is interesting to note, that although the series were not cointegrated at the five percent level of significance, there was more evidence (higher p-values) that the Kansas City Fed interest rate series were more nearly cointegrated with the 10 year bond rate than the 6-month T-bill rates. The FCS bonds were in-between the 6-month T-bill and the 10-year T-bond in terms of the strength of the bivariate cointegration test statistic.

Johansen's cointegration tests were then calculated. The results for Johansen's cointegration tests failed to reject the hypothesis that no cointegrating vectors exist for all fifteen pairwise comparisons. The general conclusion from these pairwise tests is that the interest rate series are not pairwise cointegrated in general. A stable long-run equilibrium does not exist between pairs, though a multivariate stable equilibrium does exist.

Cointegration of the Spreads

One of the hypotheses from casual observation of Figure 1 was that the farm spread (real estate loan rate minus the operating loan rate) seemed to move more closely to the treasury spread (10-year T-bond minus the 6-month T-bill) before 1984 than after 1984. This hypothesis can be examined using cointegration tests. Three Engle and Granger cointegration tests were conducted. The first examined the 1976 through the 1992 period. The second examined the 1976 through the 1984 time period. The final test examined the 1984 through 1992 period. Before the cointegration tests were performed, the series were tested to determine whether they are nonstationary[5]. The results from the augmented Dickey-Fuller tests indicate that each of the series at one unit root at the five percent level of significance. Thus, bivariate cointegration tests between the spreads can be performed.

[5] The Schwartz Bayesian Criteria indicated that the appropriate lag length for the farm spread and the government spread was 1 for each of the three time periods.

The results of the Engle and Granger cointegration tests for the 1976 through 1992 indicate that the farm spread and the treasury spread are not cointegrated at a 10 percent level of significance with a test statistic of -1.82. The results from the cointegration tests for the 1976 to 1984 period also indicated that the vectors were not cointegrated at the 10 percent level of significance with a test statistic of -2.05. The results from the cointegration tests for the 1984 to 1992 period were also not significant with a test statistic of -1.47. Comparing the calculated test statistics of the pre-1984 period with the post-1984 period lends support to the hypothesis that the relationship between the treasury spread and the farm spread was stronger in the pre-1984 period than in the post-1984 period.

Impulse Responses from the Cointegration Results

The impulse response functions measure the effect of a shock to a system of variables on the rest of the variables in the system. When calculating the impulse functions, it is necessary to determine a variable ordering for the system. The more exogenous the interest rate, the higher in the ordering that variable is placed. The interest rates were ordered as follows: 6-month T-bill, 10-year T-bond, FCS bond, feeder cattle, operating, intermediate, and real estate rates. In contrast to a VAR system, a shock to a system may result in a permanent or a transitory effect in a cointegrated system. In a VAR system, the shocks will eventually die out. A one time shock is defined as transitory if it returns to its previous equilibrium after some period of time. A shock is defined as permanent if it settles at an equilibrium different from zero.

Figure 2 examines the time path of the Kansas City interest rates to a shock in the 6-month T-bill rates. A shock in the 6-month T-bill results initially in a movement of about 35 basis points in that interest rate. The shock continues to increase before starting a general downward trend. In response to this shock in the T-bill rate, the four farm rates respond immediately to that shock on an order of about one-half. The farm lending rates continue to increase for another four quarters until they begin to follow the Treasury bill rate. After 20 periods, the real estate and the intermediate lending rate begin to diverge. This likely reflects the fact that the Kansas City rates are not cointegrated with the 6-month T-bill rate.

Figure 2. Response of Kansas City Farm Lending Rates to a Shock in the 6-Month T-Bill Rate

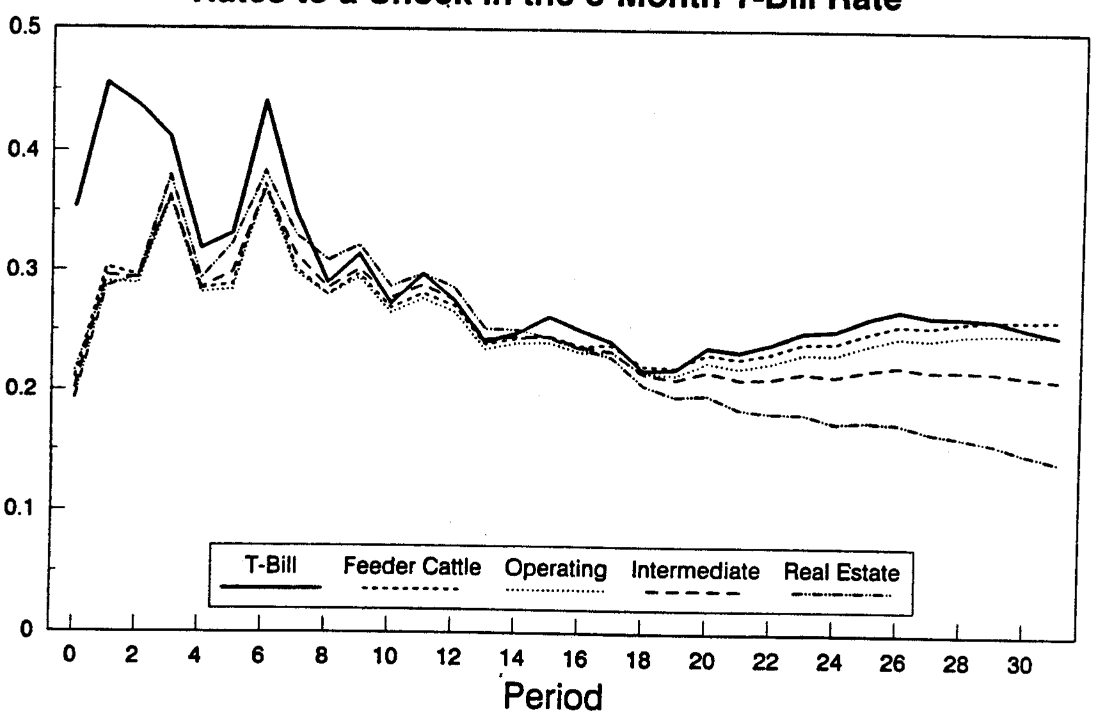


Figure 3 examines the time path of the Kansas City farm lending rates to a shock in the 10-year T-bond rate. The Kansas City rates do not respond much in the short-run to a shock in the long-run interest rate. However, after a year, the Kansas City lending rates move fairly closely with the 10-year T-bond rate. The Kansas City rates do not begin to diverge from the long-term government rate as they did in Figure 2.

Figure 3. Response of Kansas City Farm Lending Rates to a Shock in the 10-Year T-Bond Rate

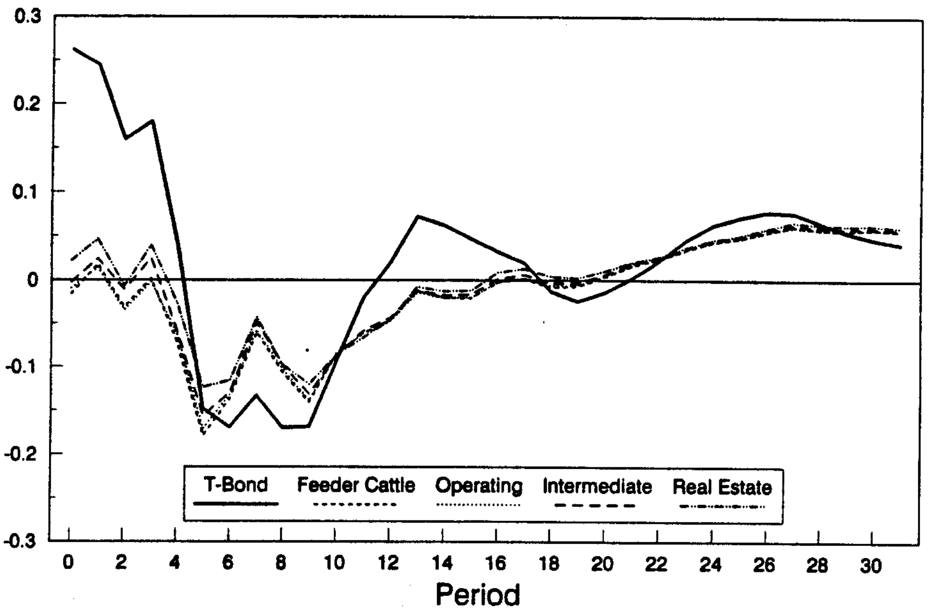
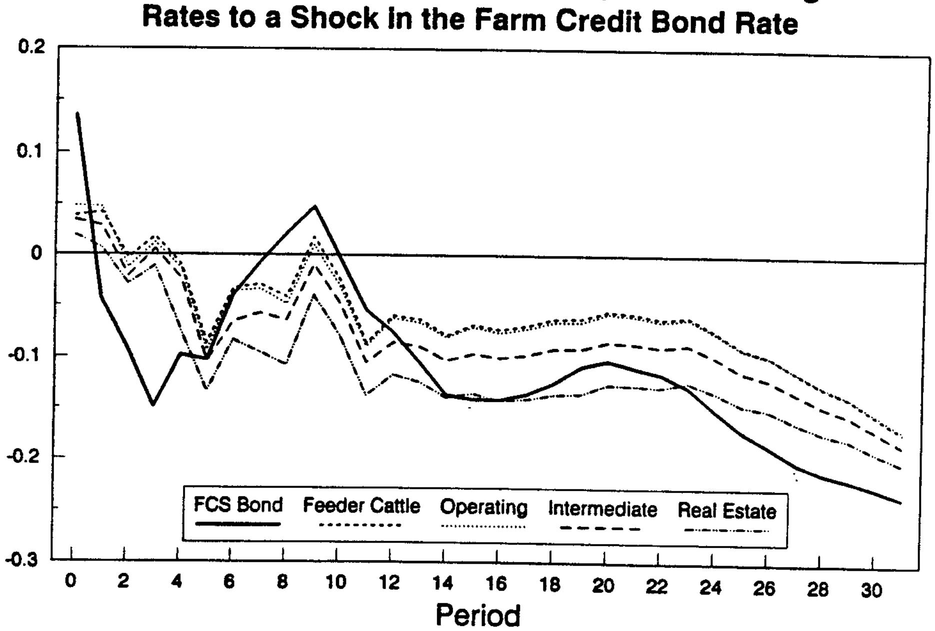


Figure 4 examines the time path of the Kansas City farm lending rates to a shock in the Farm Credit lending rate. The longer-term movement of the farm rates is not as closely aligned with the FCS rate as they are with the 10-year Treasury rate. However, it is more aligned than is the 6-month Treasury bill rate.

Figure 4. Response of Kansas City Farm Lending Rates to a Shock in the Farm Credit Bond Rate



Conclusions

This study has examined the relationship between money market interest rates and farm lending rates. The results from this study suggest that a system of 6-month Treasury bills, 10-year Treasury bonds, FCS bonds, and Kansas City feeder cattle, operating, intermediate, and real estate lending rates does have a stable long-run equilibrium. However, as macroeconomic rates are dropped from the system, we find that a system of 6-month T-bills and the four Kansas City interest rates are do not have a long-run equilibrium relationship. Two alternative five variable systems consisting of the four Kansas City lending rates and alternatively the 10-year T-bond and the FCS bond yield do have long-run stable relationships. One of the implications of these results is that short-term Treasury bill rates are not a good proxy for farm lending rates.

A second implication from this study was found by examining the relationship between the farm yield curve, as defined by subtracting the Kansas City real estate rate from the operating rate, and the treasury yield curve, as defined as the difference between the 10-year T-bond rate and the 6-month T-bill rate. The strength of the relationship between the farm yield curve and the treasury yield curve has weakened in the 1984-1992 period from the 1976-1984 period. This weakening coincides with an inversion of the farm yield curve. During every quarter except one since 1984 operating lending rates have been higher than real estate lending rates in the Kansas City Federal Reserve District. This phenomena has persisted in other regions as well as can be seen by examining lending rates for other Federal Reserve Districts (Walraven, Ott, and Rosine). An explanation of this difference may rest in a shifting in the perceived default characteristics or the cost structure associated with shorter versus longer maturity loans.

Finally, the paper examined the effect of shocks in money market interest rates on Kansas City farm lending rates. In all cases, the response of the farm lending rates to a shock in a macroeconomic rate is not highly aligned for at least four quarters. After that period of time, the rates begin to move together. Developing a plausible explanation for the weakening of the relationship between the farm spread and the treasury spread is an issue the needs further investigation.

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