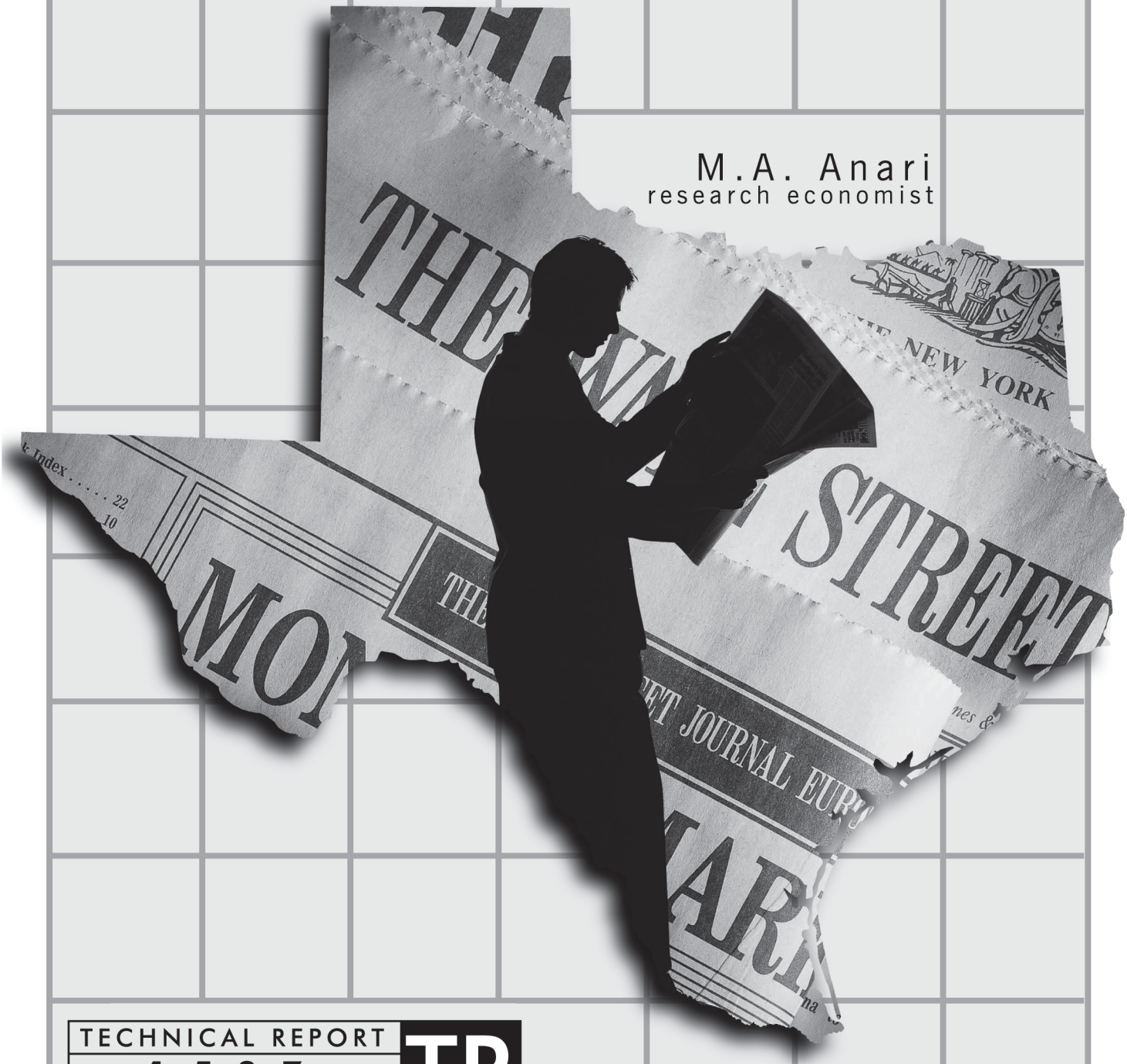
REAL ESTATE CENTER

Long-Run Impact of Fed Funds Rate on Texas Mortgage Interest Rates

M.A. Anari
research economist



TECHNICAL REPORT
1537
JANUARY 2002
TR

Long-Run Impact of Fed Funds Rate on Texas Mortgage Interest Rates

M.A. Anari
Research Economist

January 2002

Long-Run Impact of Fed Funds Rate on Texas Mortgage Interest Rates

Contents

Long-Run Impact of Fed Funds Rate on Texas Mortgage Interest Rates

M.A. Anari
Research Economist

Introduction

The federal funds rate and the discount rate are two interest rates influenced or managed by the central bank of the United States, known as the U.S. Federal Reserve Bank, a collective name for 12 Federal Reserve Banks and their 35 branches, better known in the media as the Fed. News about the Fed's decisions to vary these two key interest rates is often followed by commentaries on how these rate changes will affect the cost of borrowing for consumers and businesses. Real estate loans represent the largest component of credit market debt outstanding (Table 1).

This report describes the long-run impact of changes in the Fed funds rate and the discount rate on Texas mortgage rates. Section 1 covers how the mortgage rate is determined. Section 2 presents a brief introduction to the Fed and describes how the Fed funds rate and the discount rate are determined. In section 3, the links between the Fed funds rate and the mortgage rate are discussed. Finally, section 4 presents estimated long-run econometric relationships between the Fed funds rate and mortgage rates for the United States and Texas.

1. Determination of Mortgage Rate

Mortgages are loans for purchasing real property and are secured by the underlying property. In the absence of government intervention in mortgage markets, the mortgage rate is determined by the interaction of the supply and demand for mortgage loans. However, the U.S. government has played, and is playing, a major role in mortgage markets.

There are two markets for mortgage funds: the primary mortgage market and the secondary mortgage market.

The primary market for mortgages is the market in which the mortgage is created by the initial lender, known as an originator. In the past, local savings and loan associations were the main suppliers of original mortgages. Their role diminished significantly in the late 1980s. Today mortgage bankers and commercial banks are the most active mortgage originators. Mortgage originators may hold newly created mortgages in their portfolios, sell them directly to secondary mortgage markets or sell them as mortgage-backed securities, mainly in the form of mortgage-backed bonds and mortgage pools.

The secondary market for mortgages in the United States is an outgrowth of U.S. government intervention in mortgage markets to provide more liquidity to the primary market. Following widespread defaults by mortgage borrowers during the Great Depression, the government began to play an important role in making mortgage markets more efficient.[1] Major government-sponsored entities (GSEs) in the secondary mortgage market include the Government National Mortgage Association (GNMA or Ginnie Mae), the Farmers Home Administration, the Federal Housing and Veterans' Administrations, the Federal Deposit Insurance Corporation, the Federal National Mortgage Association (FNMA or Fannie Mae), the Federal Land Banks and the Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac).

Mortgage rates are determined by the supply of and demand for mortgages in the primary and secondary markets for purchasing four major classes of properties: one-to-four-family residences, multifamily residences, commercial and industrial real properties and farms.

Demand for residential mortgages is determined by population growth, personal income growth, mortgage interest rates and an array of socioeconomic factors. Demand for commercial and industrial mortgages is derived from the demand for the goods and services supplied by firms. To a lesser extent, this also is the case for demand for farm mortgages.

Mortgages for one-to-four-family residences account for more than three-fourths of total mortgage debt outstanding (Table 2). Mortgage pools and trusts are primary holders of mortgages originated to finance one-to-four-family residences and currently hold more than 55 percent of mortgages in this market (Table 3). Major financial institutions (commercial banks, savings institutions, and life insurance companies) held 30.8 percent of the mortgages in this market in third quarter 2000.

Financial institutions held more than 42 percent of mortgage loans for multifamily residences in third quarter 2000 (Table 4). Mortgage pools or trusts held 26.9 percent of multifamily mortgages in this market (Table 4).

Major financial institutions are primary suppliers of mortgage funds for commercial and industrial properties and held more than 68 percent of mortgages in this market in 2000 (Table 5). They also accounted for more than 42 percent of farm mortgages (Table 6).

In the U.S. economy, determination of mortgage rates is a part of the larger process of determination of interest

rates. In the absence of government intervention in credit markets, mortgage interest rates are determined by the supply of and demand for mortgage loans and expectations about interest rates. Expectations about mortgage interest rates are formed based on information about risk-free interest rates and risks associated with mortgage loans.

Risk-Free Real Interest Rates[2]

Lenders supply funds to the U.S. government by purchasing U.S. Treasury bills, notes and bonds with different maturities to obtain riskless rates of return over the term of the securities and the guaranteed return of the principal at the end of the contract period. Lenders expect to charge higher interest rates on funds to be used in risky investments.

The expected real interest rate may depend on the expected growth rate of the economy. Lenders command higher real interest rates when the economy is expected to grow rapidly and firms are more willing to pay higher interest rates on borrowed funds when they anticipate higher returns on investment projects. Generally, higher real interest rates are associated with higher expected economic growth rates and lower real interest rates are associated with lower expected economic growth.

The income tax rate is another determinant of expected yields on loanable funds because interest income is subject to income tax. Lenders consider after-tax yields when forming expectations about rates of return. For instance, for a lender whose marginal tax rate is 30 percent, a 7.14 percent yield on a corporate bond that is subject to income tax is equivalent to a 5 percent yield on a muni bond (a tax-exempt bond issued by a municipality).

If a significant proportion of loanable funds are supplied by foreigners (for instance, if Japanese investors buy U.S. bonds), expected changes in exchange rates also play a role in forming expectations about returns because foreign investors form their own expectations about returns in terms of their national currencies.

In forming expectations about yields, lenders consider yields over the lifetime of a loan. Since mortgages are long-term debts, expectations regarding mortgage yields are formed based on expected economic conditions over the lifetime of a mortgage loan.

Expected Risks

Lenders consider a number of risks before entering into contracts to offer loans. They form expectations regarding these risks, evaluate them and add risk premiums to the expected rate they can obtain on riskless investments. The adjusted expected return may include premiums for the risk of losing the purchasing power of money when the loans are repaid, default risk, interest rate risk, maturity risk, liquidity risk and reinvestment risk.

In 1870, the State of Massachusetts issued a bond that promised the payment of both interest and principal depending on the price of "five bushels of corn, sixty-eight pounds and four-sevenths part of a pound of beef, ten pounds of sheep's wool and sixteen pounds of sole leather."[3] The reason for issuing this bond was inflationary expectations. Inflation in the post-Civil War years was high and lenders were uncertain of how many bushels of corn or other commodities they would be able to purchase with the amounts of principal and interest returned to them at the loan's maturity.

Nominal interest rates contain a premium for inflation as well as other risk premiums. The inflation premium equals the expected average inflation rate expected over the life of the loan. This is an important component of mortgage rates since mortgage loans are normally long-term loans.

As the graph of average conventional 30-year mortgage rates and inflation rates in Figure 1 shows, changes in the mortgage rate have been closely associated with changes in the rate of inflation. Inflationary expectations are in fact the most important determinant of mortgage rates.

Interest rate risk, credit risk and prepayment risk are other major risks associated with mortgages. Mortgages are long-term investments typically held in the portfolios of financial institutions that pay interest on short-term deposits. The earnings of these institutions are sensitive to interest rate fluctuations and the spread between mortgage rates and interest rates paid on deposits. Interest rate risk can be higher when interest rates are expected to decrease because homeowners (mortgagors) can refinance their debt as rates fall.

Credit risk refers to late payments or default. Since 1983, the default rate on mortgages has generally increased.

Mortgage lenders are exposed to prepayment risk because the law allows mortgagors to prepay the principal balances on their mortgages without penalty. When this happens, expected future income from a mortgage is reduced. Prepayment risk also exposes mortgage lenders to reinvestment risk because they must find new investment opportunities for the prepaid mortgage funds. Those opportunities are expected to generate less income than the mortgages that are paid off early.

Because of these different risks, there is a spread between mortgage rates and rates (or yields) on riskless treasury bonds. In the long run, this spread reflects the price or compensation paid by borrowers to lenders for incurring these risks.

2. Federal Reserve System and Interest Rates

The Federal Reserve System was established by Congress in 1913 to ". . . furnish an elastic currency, to afford means of rediscounting commercial paper, to establish a more effective supervision of banking in the United States, and for other purposes." Since its creation, the Fed's duties have been extended to include the broad responsibilities of conducting the nation's monetary policy to achieve price stability and full employment, supervising the nation's financial system and providing certain financial services. The Federal Reserve Act specifies that the Federal Reserve System should seek "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

To achieve the goals of price stability and full employment, the Fed needs to control four key macroeconomic variables: real output, price level, money supply and interest rates. In a free market economy, neither a central bank nor any other entity holds significant power to control real output, price levels or demand for money because these variables are determined by decisions made by

households and businesses. As for the money supply, according to Article I of the U.S. Constitution, "Congress shall have the power to coin money and regulate the value thereof." Congress delegated this power to the Fed in the Federal Reserve Act of 1913. The Fed's main instrument for implementing monetary policy is control of the money supply.

The Fed controls the money supply using three tools. First, it can and does expand or shrink the money supply by changing the "reserve requirement" for all banks. The reserve requirement is the amount of money a depository institution must hold in reserve in its vault or on deposit at other depository institutions. Changes in the reserve requirements do not happen frequently.

Second, the Fed can change the money supply by selling and buying treasury securities. When the Federal Open Market Committee authorizes and directs the Federal Reserve Bank of New York to buy U.S. government securities from any seller, it injects money into the economic system, thereby increasing the money supply.

Finally, the Fed can influence the money supply by lowering or raising two key interest rates: the discount rate and the federal funds rate. The discount rate is the interest rate the Fed charges an eligible depository institution when that institution borrows funds directly from the Fed. This rate is typically for a short period and is under direct control of the Fed.

The federal funds rate is the interest rate charged by depository institutions when they borrow "overnight" from each other. The Fed changes the federal funds rate indirectly by selling or purchasing U.S. treasury securities via open market operations. When the Fed sells U.S. treasury securities, banks' reserves at the Fed drop. To meet the reserve requirements, banks have to borrow from each other and the resulting higher demand for interbank lending leads to higher Fed funds rates.

3. Link Between Fed Funds Rate and Mortgage Rate

The link between the Fed funds rate and the mortgage rate, and the links between interest rates on various types of loans and securities, are the result of the supply and demand for loanable funds and different types of bonds and expectations regarding yields and risks on various types of loans and securities. The supply and demand for various funds and bonds determine interest rates, while expectations about returns and risks lead to changes in the supply and demand for bonds and loanable funds. The term structure of interest rates, which is the relationship between interest rates and the time to maturity, is the outcome of the interaction of the supply and demand for various bonds and expectations regarding risks and returns.

There are four theories regarding the term structure of interest rates (or the yield curve). The *expectation theory* states that investors' expectations about future inflation rates shape the yield curve. The *market segmentation theory* states that instruments with different maturities are not perfect substitutes for each other and that interest rates on these securities are determined in separate markets by the interactions of market-specific supply and demand considerations. The *preferred habitat theory* asserts that securities with different maturities are substitutes for each other but not perfect ones. Finally, the *liquidity preference theory* of interest rates states that lower interest rates on short-term debt securities reflect the greater liquidity and lower interest rate risk associated with these debt instruments. Each of these theories partially explains the relationship between interest rates and time to maturity.

According to these theories, changes in the Fed funds rate and the discount rate are transmitted to short-term interest rates and these rates in turn transmit the changes to longer-term rates, including the mortgage rate. Changes in the Fed funds rate initially impact interest rates on funds with short-term maturities, such as saving accounts and one-month certificates of deposits, which pay monthly interest.

As Figure 2 and Table 7 show, the Fed funds rate and the interest rate on one-month certificates of deposit have been essentially identical. The mean spread between these two rates over a sample period from January 1965 to June 2000, a total of 426 monthly observations, was just one basis point (Table 8). At the other end of maturity structure, the mortgage rate falls between yields on AAA and BAA corporate bonds (Table 7 and Figures 3 and 4). The mean spread between the mortgage rate and the yield on BAA corporate bonds over the sample period was 19 basis points (Table 8).

Figure 5 shows the spread between the average 30-year FHA mortgage rate and the Fed funds rate from January 1965 to June 2000. The Fed funds rate was higher than mortgage rates in only 45 months out of 426 monthly observations. The Fed funds rate may exceed the mortgage rate in three situations. First, it may do so if long-run inflation rates are expected to be less than short-term inflation rates. Second, it may occur if the Fed raises the Fed funds rate as a measure to curb expected inflation. In this case, the reaction of market participants — i.e., their long-run inflationary expectations — depends on the credibility of the central bank to curb inflation in the long run. Finally, higher demand for and/or lower supply of short-term loans relative to long-term loans in segmented markets for short-term and long-term loans may result in short-term interest rates that exceed long-term rates.

The months in which mortgage rates were higher than the Fed funds rate account for 89.4 percent of the monthly observations during the sample period. The mean spread between the two rates over the sample period (mortgage rate minus the Fed funds rate) was 234 basis points (Table 8). Thus, in the short run the Fed funds rate and the mortgage interest rates may temporarily move in opposite directions, but in the long run higher mortgage interest rates are associated with higher Fed funds rates and lower mortgage interest rates are associated with lower Fed funds rates.

4. Long-Run Relationships Between Mortgage Rates and the Fed Funds Rate

There are econometric methods (cointegration techniques) for the estimation of long-run relationships between time series variables when in the short run they may deviate from each other (move in opposite directions). For this research, the maximum likelihood procedure of Johansen (1988) and Johansen and Juselius (1990) is employed. The mathematics underlying the procedure are quite

complex and only the final results are presented in this section. Using the maximum likelihood procedure, the following two models of long-run relationships between the mortgage rate (*MRATE*) and the Fed funds rate (*FEDFR*) are estimated:

Ratio Model: $MRATE = bFEDFR$ (1)

Spread Model: $MRATE = a + bFEDFR$ (2)

Specification (1) assumes that the ratio of the mortgage rate to the Fed funds rate is equal to a constant (*b*) in the long run. In this model the long-run spread between the mortgage rate and the Fed funds rate is a variable that depends on the average Fed funds rate in the long run. The spread is defined as *(b-1)FEDFR*. In specification (2), the spread is a constant represented by the constant term *a*, provided that the estimate of *b* is close to unity. The underlying equation for the estimation of these relationships is derived from a version of the expectation theory that states that there is a stable long-run relationship between the long-term and short-term interest rates and that, for a given holding period, the long-term rate is a weighted average of present and expected future short-term rates (Vasicek [1977], Richard [1978], Cox, Ingersoll and Ross [1985], Fama [1984], Campbell and Shiller [1987]).

U.S. Mortgage Interest Rates

Table 9 presents the estimated long-run relationships between mortgage interest rates for 30-year, fixed-rate conventional mortgages and the Fed funds rate. The mortgage rates are national averages of regional rates. As panel A of the table shows, in the long run, the average ratio of the conventional 30-year contract mortgage rate to the Fed funds rate is 1.24. That is, on average, the conventional 30-year mortgage rate is 24 percent higher than the Fed funds rate. This ratio suggests that the spread between the mortgage rate and the Fed funds rate is about 24 percent of the average Fed funds rate. The spread is slightly higher for the effective mortgage rate (contract mortgage rates plus points).

In panel B, the estimated coefficients of the Fed funds rate are close to unity, so the estimated constant terms can be considered as the long-run spread between the mortgage rate and the Fed funds rate. In the long run, the average spread between the contract mortgage rate and the Fed funds rate is 234 basis points. The spread is smaller, 216 basis points, for the effective mortgage rate.

Texas Mortgage Interest Rates

The average contract mortgage interest rate for 30-year conventional mortgages in Texas was 9.58 percent between 1978 and 2000 (Table 10). The average effective mortgage rate (contract mortgage rate plus points) for the same period was 36 basis points higher than the average contract rate. The average spread between the average effective mortgage rate for Texas and the average inflation rate for Dallas, calculated from Dallas' consumer price index, was 519 basis points for the sample period. The average spread between the average effective mortgage rate for Texas and the average Fed funds rate was 230 basis points (Table 10).

As Table 11 shows, the coefficient of the Fed funds rate in the estimated equation for Texas' conventional 30-year effective mortgage rate is 1.25, suggesting that, in the long run, the average effective mortgage rate exceeded the Fed funds rate by 25 percent of the average Fed funds rate. In other words, the spread between the two rates is about 25 percent of the average Fed funds rate. The spread is 20 percent of the average Fed funds rate for contract mortgage rates.

The estimated long-run relationships between the discount rate and mortgage rates were very similar to those obtained for the Fed funds rate, as presented in Tables 9 and 11, and are not reported here.

Table 1. Credit Market Debt Outstanding
End of Third Quarter 2000

Credit Instrument	Debt Outstanding (Billions of Dollars)	Percentage of Total
U.S. government securities	7,574.4	28.1
Mortgages	6,817.7	25.3
Corporate and foreign bonds	4,929.0	18.3
Municipal securities	1,550.3	5.8
Consumer credit	1,495.6	5.5
Bank loans	1,471.7	5.5
Other loans and advances	1,545.0	5.7
Open market paper	1,568.3	5.8
Total	26,952.0	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 2. Mortgage Debt Outstanding by Type of Property
End of Third Quarter 2000

Type of Property	Debt Outstanding (Millions of Dollars)	Percentage of Total
One-to-four-family residences	5,104,650	75.0
Multifamily residences	399,882	5.9
Commercial and industrial properties	1,191,463	17.5
Farms	107,232	1.6
Total	6,803,227	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 3. Holders of One-to-Four-Family Residential Mortgages
Third Quarter 2000

Holders	Mortgage Debt (Millions of Dollars)	Percentage of Total
Major Financial Institutions	1,569,540	30.8
Commercial Banks	968,069	
Savings Institutions	595,472	
Life Insurance Companies	5,999	
Federal and Related Agencies	203,806	4.0
Government National Mortgage Association	6	
Farmers Home Administration	16,444	
Federal Housing and Veterans' Administrations	1,327	
Federal Deposit Insurance Corporation	13	
Federal National Mortgage Association	141,786	
Federal Land Banks	2,092	
Federal Home Loan Mortgage Corporation	42,138	
Mortgage Pools or Trusts	2,829,430	55.6
Government National Mortgage Association	584,318	
Federal Home Loan Mortgage Corporation	786,007	
Federal National Mortgage Association	981,206	
Private Mortgage Conduits	477,899	
Individuals and Others	487,534	9.6
Total Mortgage Debt Outstanding on 1-to-4 Family Properties	5,090,310	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 4. Holders of Multifamily Residential Mortgages
Third Quarter 2000

Holders	Mortgage Debt (Millions of Dollars)	Percentage of Total
Major Financial Institutions	170,195	42.5
Commercial Banks	76,945	
Savings Institutions	60,044	
Life Insurance Companies	33,206	
Federal and Related Agencies	40,594	10.1
Farmers Home Administration	11,734	
Federal Housing and Veterans' Administrations	2,608	
Federal Deposit Insurance Corporation	16	
Federal National Mortgage Association	11,328	
Federal Home Loan Mortgage Corporation	14,908	
Mortgage Pools or Trusts	107,495	26.9
Government National Mortgage Association	18,476	
Federal Home Loan Mortgage Corporation	4,884	
Federal National Mortgage Association	39,622	
Private Mortgage Conduits	44,513	
Individuals and Others	81,808	20.5
Total Mortgage Debt Outstanding on Multifamily Properties	400,092	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 5. Holders of Commercial and Industrial Mortgages
Third Quarter 2000

Holders	Mortgage Debt (Millions of Dollars)	Percentage of Total
Major Financial Institution	816,409	68.5
Commercial Banks	569,801	
Savings Institutions	65,441	
Life Insurance Companies	181,167	
Federal and Related Agencies	40,708	3.4
Farmers Home Administration	40,665	
Federal Deposit Insurance Corporation		53
Mortgage Pools or Trusts	175,899	14.8
Private Mortgage Conduits	175,899	
Individuals and Others	158,437	13.3
Total Commercial and Industrial Mortgages	1,191,463	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 6. Holders of Farm Mortgages in 1998

Holders	Mortgage Debt (Millions of Dollars)	Percentage of Total
Major Financial Institutions	47,569	42.5
Commercial Banks	33,919	
Savings Institutions	531	
Life Insurance Companies	13,119	
Federal and Related Agencies	4,167	36.8
Farmers Home Administration	4,167	
Individuals and Others	22,039	20.7
Total Mortgage Debt Outstanding on Nonfarm Nonresidential	73,775	100.0

Source: *Federal Reserve Bulletin*, May 2001

Table 7. Descriptive Statistics for Selected Interest Rates, January 1965 to June 2000

Statistics	Federal Funds Rate	One-month CDs	AAA Bond Yield	BAA Bond Yield	30-Year Mortgage Rate
Mean	7.11	7.12	8.59	9.63	9.45
Median	6.09	6.09	8.21	9.12	8.82
Maximum	19.10	19.24	15.49	17.18	18.55
Minimum	2.92	3.07	4.41	4.78	5.44
Standard Deviation	3.12	2.94	2.27	2.64	2.52

Source: Federal Reserve Bank of St. Louis

Table 8. Descriptive Statistics for Selected Spreads, January 1965 to June 2000

Statistics	One-month CD minus the Fed Rate	Mortgage rate minus the Fed Rate	Mortgage rate minus AAA bonds	BAA bonds minus mortgage rate
Mean	0.01	2.34	0.85	0.19
Median	0.01	2.58	0.81	0.16
Maximum	1.09	6.17	3.21	2.00
Minimum	–1.55	–5.00	–0.36	–1.44
Standard Dev.	0.36	1.81	0.48	0.51

Sources: Federal Reserve Bank of St. Louis and Real Estate Center at Texas A&M University

Table 9. Long-Run Relationships Between U.S. Mortgage Rates and the Fed Funds Rates

Sample Period: 1964 to 2000			
A. Ratio Models			
Contract mortgage rates:	USCMR = 1.24 FEDFR (0.04)*	$R^2 = 0.77$	D.W. = 2.08
Effective mortgage rates:	USEMR = 1.27 FEDFR (0.04)*	$R^2 = 0.78$	D.W. = 2.05
B. Spread Models			
Contract mortgage rates:	USCMR = 2.34 + 0.93 FEDFR (0.43)* (0.06)*	$R^2 = 0.77$	D.W. = 1.91
Effective mortgage rates:	USEMR = 2.16 + 0.99 FEDFR (0.47)* (0.06)*	$R^2 = 0.81$	D.W. = 1.94

* Means significant at 5 percentage significance level. R^2s and Durbin-Watson statistics are for error-correction models in cointegration analysis.

Table 10. Descriptive Statistics for Texas Mortgage Rates, Texas Inflation Rates and the Fed Funds Rate Annual Sample From 1978 to 2000

Statistics	Contract Rate	Effective Rate	Inflation Rates		Fed Funds Rate
			Dallas	Houston	
Mean	9.58	9.94	4.75	4.31	7.64
Median	9.46	9.72	2.99	3.15	6.80
Maximum	14.48	15.47	16.93	13.19	16.38
Minimum	6.99	7.13	1.36	–0.91	3.02
Standard Deviation	2.15	2.38	3.91	3.71	3.31

Sources: Texas mortgage rates are from Federal Home Loan Mortgage Corporation; inflation rates are calculated using consumer price indexes for Dallas and Houston from the U.S. Bureau of Labor Statistics; the Fed funds rate is from Federal Reserve Bank of St. Louis.

Table 11. Long-Run Relationships Between Texas Mortgage Rates and the Fed Funds Rates

Sample Period: 1978 to 2000		
Contract mortgage rates:	TXCMR = 1.20 FEDFR (0.06)*	$R^2 = 0.36$ D.W. = 1.8
Effective mortgage rates:	TXEMR = 1.25 FEDFR (0.06)*	$R^2 = 0.34$ D.W. = 1.91

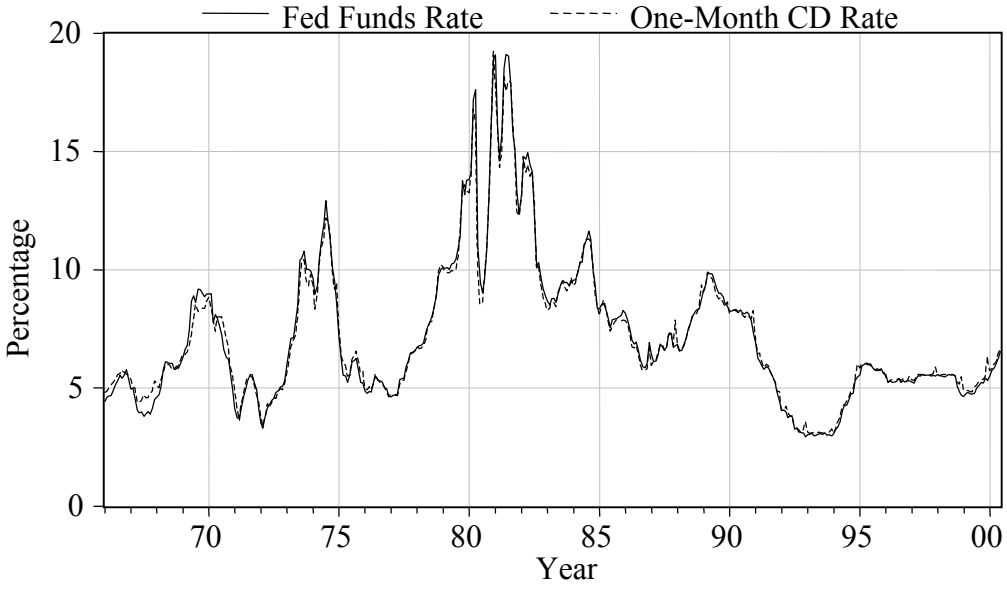
* Means significant at 5 percent significance level. R^2s and Durbin-Watson statistics are for error-correction models in cointegration analysis. Smaller R^2 s, compared with table 9, are due to shorter sample period for Texas data.

Figure 1. Average Conventional 30-Year Mortgage Rates and Inflation Rates

Notes: Inflation rates are estimated using GDP implicit deflator. Inflation rates from 1972–1974 are underestimated due to price controls during the Nixon administration. After the end of price controls in 1974, inflation rates recovered almost all ground lost during the price control era. Inflation rates for 1974 and 1975 are overestimated.

Sources: Federal Reserve Bank of St. Louis and U.S. Bureau of Labor Statistics

Figure 2. Federal Funds Rate and One-Month CD Rate



Source: Federal Reserve Bank of St. Louis

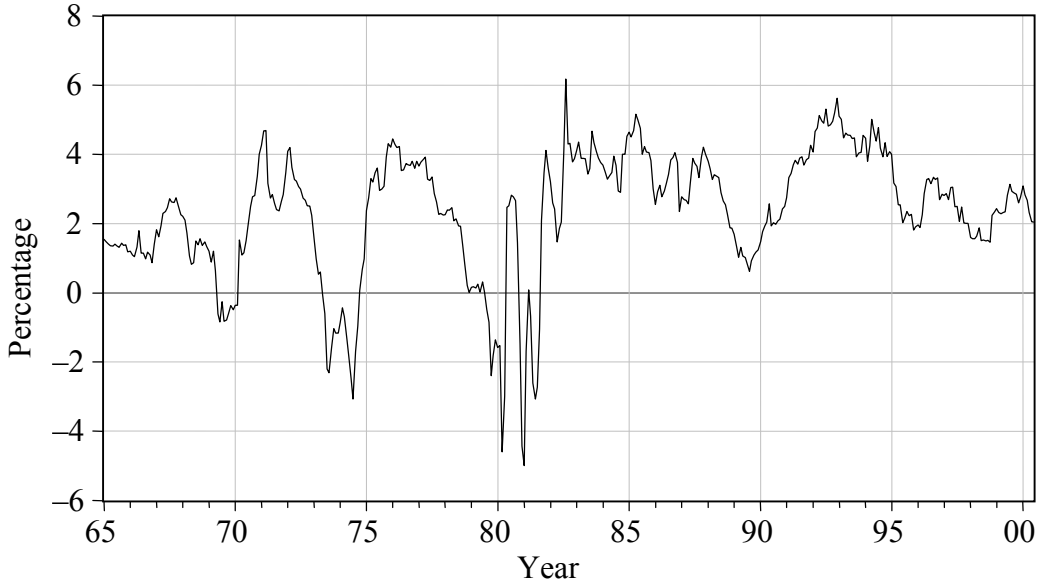
Figure 3. Average Conventional 30-Year Mortgage Rates and Yields on AAA Corporate Bonds

Source: Federal Reserve Bank of St. Louis

Figure 4. Average Conventional 30-Year Mortgage Rates and Yields on BAA Corporate Bonds

Source: Federal Reserve Bank of St. Louis

Figure 5. Spread Between Average FHA 30-Year Mortgage Rates and Fed Funds Rates



Source: Federal Reserve Bank of St. Louis

102-25-1537

Endnotes

[1] For a review of the history of government intervention in credit markets see Cooper and Fraser (1990) Chapters 5, 11, 12 and 20.

[2] The interest rates observed are nominal interest rates. The real interest rate is the nominal interest minus the inflation rate. Inflation rates are calculated using a price index for goods such as the consumer price index (CPI) or the producer price index (PPI), available on a monthly basis, or GDP implicit deflator, available on a quarterly basis. Using the CPI, inflation rate for a period from *t* to *t+1* is calculated as: $inflation\ rate=100*(CPI_{t+1} - CPI_t)/CPI_t$.

[3] *London Economist*, May 25, 1996, page 84.

References

Cambell, J.Y. and Shiller, R. 1987. "Cointegration and Tests of Present Value Models," *Journal of Political Economy*, 95 (5):191–217.

Cooper, S.K. and Fraser, D.R. 1990. *The Financial Marketplace.* New York: Addison-Wesley Publishing Company.

Cox, J.C., Ingersoll Jr., J.E. and Ross, S.A. 1985. "A Theory of the Term Structure of Interest Rates," *Econometrica*, 53:385–407.

Fama, E.F. 1984. "The Information in the Term Structure," *Journal of Financial Economics*, 13:509–528.

Johansen, S. 1988. "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, 12:231–254.

Johansen, S. and Juselius, K. 1990. "Maximum Likelihood Estimation and Inference on Cointegration — An Application for Demand for Money," *Oxford Bulletin of Economics and Statistics*, 52:169–210.

Richard, S.F. 1978. "An Arbitrage Model of the Term Structure of Interest Rates," *Journal of Financial Economics*, 6:33–57.

Vasicek, O. 1977. "An Equilibrium Characterization of the Term Structure," *Journal of Financial Economics*, 5:177–188.