JOURNAL OF REAL ESTATE RESEARCH

The Sensitivity of Bank Stocks to Mortgage Portfolio Composition

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Abstract. **Previous studies have found that bank stock returns are very sensitive to changes in real estate returns in general. But how the composition and quality of bank real estate portfolios affect the sensitivity of bank stocks to real estate returns has not been rigorously examined. The purpose of this study is to empirically examine this important question.**

The results indicate that commercial mortgages contribute the most to the sensitivity of bank stock returns. Farmland loans have a negative impact on bank real estate return sensitivity. Thus, farmland loans could play a diversification role in terms of reducing the sensitivity of banks to real estate returns, if used appropriately.

Introduction

Default risk is the major risk of mortgage lending. Mortgages are essentially a bond and mortgage default risk is the probability of loss faced by financial institutions when borrowers default on their mortgage obligations. If the outstanding mortgage balance is greater than the net proceeds from the sale of a property in default, a book value loss occurs for the financial institutions holding the mortgage. When the difference between the expected net sale proceeds and the mortgage balance is negative, the property owner may decide to default on the mortgage and pass this negative value to the mortgagee (Anderson and Weinrobe, 1986; Furstenberg and Green, 1974a, 1974b; Campbell and Dietrich, 1983).

Clearly, changes in real estate returns, reflected in changes of property value, can have a significant effect on bank risk and profitability. In other words, real estate returns should be a relevant factor in terms of explaining bank stock returns and risks. Mei and Saunders (1991) and He, Myer and Webb (1996) provide evidence about the sensitivities of bank stock returns to real estate returns. He et al. (1996) find that bank stock returns are very sensitive to changes in real estate returns (proxied by the equally weighted returns on mortgage REITs).

However, a more direct and perhaps important question is how the composition and quality of bank real estate portfolios affect bank stock sensitivities to real estate returns. Potentially, banks can have five types of real estate loans: construction and development loans, farmland loans, one-family residential loans, five-or-more-family residential loans, and nonfarm and nonresidential loans. These five types of real estate loans are used in this study to test for the effect of mortgage portfolio composition. In order to test for the

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Date Revised—September 1944; Accepted—February 1995.

effects of mortgage portfolio quality, past due real estate loans, nonaccrual real estate loans, charge-off real estate loans, and recovery real estate loans are used.

The remainder of this study is organized as follows. Section two describes the methodology and data. Section three presents the empirical results, and the fourth section contains the conclusions.

Methodology and Data

Methodology

In order to examine how different types of real estate loans and the quality of real estate loans affect the sensitivity of bank stocks to real estate returns, this study employs a two-step regression analysis method similar to that used by Flannery and James (1984).

First, the sensitivity of each bank holding company to real estate returns is estimated by using a three-index model suggested by He et al. (1996):

$$\tilde{R}_{jt}=\beta_{oj}+\beta_{mt}\tilde{R}_{mt}+\beta_{Ij}\tilde{I}_t+\beta_{Rt}\tilde{R}_{Rt}+e_{jt}\,, \tag{1}$$

where $\tilde{R}_{jt}$ is the weekly return of individual bank holding company j at time t. $\tilde{R}_{mt}$ is the market return; $\tilde{I}_t$ is the interest rate proxy; $\tilde{R}_{Rt}$ is the real estate return; β_{mj} is the bank stock's sensitivity to the overall stock market; β_{Ij} is the sensitivity of bank stock returns to the interest rate; β_{Rj} is the sensitivity of bank stock returns to real estate returns; β_{oj} is the intercept; and $\tilde{e}_{jt}$ is the error term with $E(\tilde{e}_{jt})=0$ and is assumed not to be serially correlated. In order to estimate the real estate return *betas,* the CRSP weekly equally weighted index (EWRTW) is used as the market return proxy, the unexpected changes in weekly yields on long-term U.S. government bonds (YLDW) represent the interest-rate factor, and the real estate return proxy is the weekly return index for mortgage real estate investment trusts (MREITW). The use of MREITW as the real estate proxy reflects the fact that one of the major real estate risks facing banks is mortgage default risk. For most banks, there is very little direct ownership of real estate. Therefore, MREITW is an appropriate proxy of real estate returns, at least for a study of the sensitivity of bank stocks to mortgage portfolio composition. However, the weekly return index for equity real estate investment trusts (EREITW) is also tested as the real estate return proxy.

Then the following cross-sectional regression analysis is performed:

$$\hat{\beta}_{Rj}=\gamma_{oj}+\sum_{i=1}^{n}\gamma_{ij}\tilde{R}_{ij}+\mu_{oj}\,, \tag{2}$$

where,

$\hat{\beta}_{Rj}$ = the estimated real estate sensitivity of an individual bank holding company (BHC) from equation (1);
γ_{oj} = intercept;
γ_{ij} = coefficients;
$\tilde{R}_{ij}$ = average annual real estate ratios for the composition and quality of mortgage loan portfolios; and
μ_{oj} = random error term.

To calculate the average annual real estate ratios (described below), the sum of each real estate ratio over the sample period is divided by the number of years. The following six average annual real estate ratios are used to test for the effect of the composition of bank mortgage portfolios:

R_1 = construction and land development loans/total loans;
R_2 = farmland loans/total loans;
R_3 = one-to-four-family residential loans/total loans;
R_4 = multifamily residential loans/total loans;
R_5 = nonfarm and nonresidential loans/total loans; and
R_6 = total real estate loans/total loans.

The effect of bank mortgage portfolio quality is tested using the following four average annual real estate ratios:

R_7 = past due ninety-plus-day real estate loans/total past due loans;
R_8 = nonaccrual real estate loans/total nonaccrual loans;
R_9 = charge-off real estate loans/total charge-off loans; and
R_{10} = recovery real estate loans/total recovery loans.

The use of average annual ratios, as suggested by Flannery and James (1984), may significantly reduce the amount of information provided by the ratios, since average ratios often do not accurately reflect the ratio changes over time. For example, the average ratio of 50% for a three-year period could be 1) 50% each year or, 2) the mean of 80%, 50% and 20%. However, in the first case, the ratio did not change over time, but in the second case, the ratio changed dramatically over time. To overcome this potential problem, this study also uses the actual annual ratios, in addition to the annual mean ratios.

In order to use annual ratios for each BHC, annual real estate *betas* for each BHC over the six-year sample period are required. Based on weekly data, six annual (1986–1991) real estate *betas* for each BHC are obtained from equation (1). Then, the six annual real estate *betas* were regressed against the different annual mortgage ratios for each individual BHC using equation (2).

Since equation (1) estimates individual *betas* for each BHC, the potential problem of heteroskedasticity exists, in addition to potential multicollinearity and autocorrelation problems. The assumption of homoskedasticity is only deemed plausible in aggregate models (Kmenta, 1986). When microeconomic data are used, the observations may contain substantial differences in magnitude. Heteroskedasticity causes the estimate for the variance of the error term to be dependent on the particular set of values that were chosen for the independent variables. Another set of observations may yield a much different estimate of this variance. As a result, tests of the statistical significance for the individual regression coefficients (the *t*-test) and the overall explanatory power of the regression equation (the *F*-test, *R*-square) may prove to be erroneous and misleading. Therefore, for this part of the study a test of the first and second moments is performed in an attempt to detect any heteroskedasticity problems. Whenever heteroskedasticity was detected, White's (1980) Heteroskedasticity-Consistent Covariance Matrix Estimation technique was performed to correct the estimates for an unknown form of heteroskedasticity.

Data

This study covers the period from January 1986 through December 1991. A total of 239 publicly traded bank holding companies (BHCs) were obtained from the Compustat Data Base. At the end of 1991, 142 were active, and 97 were inactive. Only those that had valid information on the CRSP tapes and the FDIC Call Reports during the sample period were used. There were 156 BHCs in 1986, 152 BHCs in 1987, 145 BHCs in 1988, 139 BHCs in 1989, 136 BHCs in 1990, and 132 BHCs in 1991. The total number of BHCs in the sample period is 166.[1] The equally weighted weekly returns of BHC portfolios were created by compounding daily returns from the CRSP NYSE/AMEX and OTC tapes.

The proxy for interest rates used in this study is the unexpected changes in the weekly yields on constant maturity long-term U.S. government bonds (thirty-year) from the *Federal Reserve Bulletin.* Similar to Flannery and James (1984), in order to estimate the unexpected changes in yields on long-term U.S. government bonds, the percentage changes in the yields are first calculated by using the following equation:

$$\Delta\%yield_t = (yield_t - yield_{t-1}) \,/\, yield_{t-1}\,, \tag{3}$$

where $\Delta\%yield_t$ = percentage changes in the yields during period t.

Then the following AR(3) model is estimated:

$$\Delta\%yield_t = a_0 + a_1\Delta\%yield_{t-1} + a_2\Delta\%yield_{t-2} + A_3\Delta\%yield_{t-3} + \omega_t\,. \tag{4}$$

The residual, ω_t, represents the unexpected changes in the yields and therefore replaces the interest-rate proxy in equation (1).

The CRSP equally weighted market index was used as the proxy of R_{mt}, and an equally weighted index of returns for mortgage real estate investment trusts (REITs) was computed using the CRSP tapes and used as the proxy for real estate returns, R_{Rt}. The number of mortgage REITs identified in each sample year from the *REIT Sourcebook: A Complete Guide to the Modern Real Estate Investment Trust Industry* (NAREIT) is as follows: twenty-eight in 1986, thirty-one in 1987, thirty-five in 1988, thirty-eight in 1989, thirty-eight in 1990, and thirty-nine in 1991.

The data for real estate loans in the FDIC Call Report were taken from *Ferguson & Company's BankSource.* Since detailed information about real estate loans is not available on Ferguson's database for bank holding companies, the detailed data of all individual banks that belong to the same bank holding company were merged. This may slightly underestimate the quantity of real estate loans for bank holding companies, since some bank holding companies could conceivably have real estate loans in subsidiaries other than their banks. However, for most BHCs, the amount of total real estate loans reported in the FDIC Call Report is very close to that in the merged data created by this study.

The descriptive statistics and Pearson correlations for the ten real estate loan composition and quality ratios used in this study are presented in Exhibits 1 and 2. Banks invested the most in the one-to-four-family residential loans ($R3$) with a mean ratio of 17.343 (Exhibit 1). The second type of real estate loan most heavily invested in was nonresidential loans ($R5$). Banks invested the least in the farmland loans ($R2$); the mean ratio was 0.455 (Exhibit 1). Among the ten ratios, two quality ratios ($R7$ and $R8$) and the total real estate loan ratio ($R6$) are significantly correlated with the five real estate loan

Exhibit 1
Descriptive Statistics for Real Estate Type and Quality Loan Ratios: 1986–1991

Variable	N	Mean	Std Dev.	Minimum	Maximum
*R*1	166	7.401	5.550	.080	33.400
*R*2	166	.455	.577	.000	3.020
*R*3	166	17.343	8.257	.280	52.520
*R*4	166	1.164	1.472	.000	12.170
*R*5	166	12.547	6.836	.780	46.030
*R*6	166	38.937	13.817	1.960	82.590
*R*7	166	30.052	16.834	.000	77.000
*R*8	166	39.318	19.617	.000	95.750
*R*9	166	15.483	11.799	.000	83.810
*R*10	166	8.267	6.466	.000	39.280

*R*1 = Construction and development loans/total loans
*R*2 = Farmland loans/total loans
*R*3 = one-to-four-family residential loans/total loans
*R*4 = Multifamily residential loans/total loans
*R*5 = Nonresidential loans/total loans
*R*6 = Total real estate loans/total loans
*R*7 = Past due real estate loans/total past due loans
*R*8 = Nonaccrual real estate loans/total nonaccrual loans
*R*9 = Charge-off real estate loans/total charge-off loans
*R*10 = Recovery real estate loans/total recovery loans

Source: The Authors

type ratios (*R*1–*R*5). The four mortgage loan quality ratios (*R*7–*R*10) are also highly correlated with each other (Exhibit 2). To avoid potential multicollinearity problems, only selected ratio combinations are used in the second stage regression analysis (equation (2)).

Results

In order to examine the overall impact of the composition and quality of mortgage portfolios on the sensitivity of bank stock returns to real estate returns, the real estate return *betas* for each individual bank holding company were estimated using equation (1). For this purpose, the EWRTW, YLDW and MREITW were used as the proxy of the market return, interest-rate, and the real estate return, respectively. A BHC was dropped from a particular sample year if its return data was missing for twenty or more weeks in that year. The actual number of BHCs included in each sample year are as follows: 153 BHCs in 1986, 148 BHCs in1987, 142 BHCs in 1988, 137 BHCs in 1989, 133 BHCs in 1990; and 127 BHCs in 1991. The real estate return *betas* over the entire sample period for each BHC are reported in the Appendix. After the individual real estate return *betas* were estimated, the estimates were regressed against the ten real estate composition/quality loan ratios for each individual BHC.

The results, using average ratios, over the entire sample period are summarized in Exhibit 3, and the results based upon the annual ratios for each year are presented in Exhibit 4. They do not indicate any multicollinearity problems. The highest condition

Exhibit 2
Pearson Correlation for Real Estate Loan Ratios

	*R*1	*R*2	*R*3	*R*4	*R*5	*R*6	*R*7	*R*8	*R*9	*R*10
*R*1	1.000									
*R*2	−.138	1.000								
	.077									
*R*3	−.150	.122	1.000							
	.054	.117								
*R*4	.078	−.001	.120	1.000						
	.315	.993	.124							
*R*5	.201	.176	.274	.266	1.000					
	.009	.023	.000	.001						
*R*6	.413	.149	.688	.342	.773	1.000				
	.000	.055	.000	.000	.000					
*R*7	.304	.164	.341	.196	.298	.499	1.000			
	.000	.034	.000	.011	.000	.000				
*R*8	.280	.243	.340	.093	.645	.653	.331	1.000		
	.000	.002	.000	.234	.000	.000	.000			
*R*9	.246	.119	.068	.059	.285	.291	.222	.474	1.000	
	.001	.128	.384	.448	.000	.000	.004	.000		
*R*10	.034	.229	.181	.085	.208	.243	.133	.285	.668	1.000
	.667	.003	.020	.274	.007	.002	.089	.000	.000	

*R*1 = Construction and development loans/total loans
*R*2 = Farmland loans/total loans
*R*3 = One-to-four-family residential loans/total loans
*R*4 = Multifamily residential loans/total loans
*R*5 = Nonresidential loans/total loans
*R*6 = Total real estate loans/total loans
*R*7 = Past due real estate loans/total past due loans
*R*8 = Nonaccrual real estate loans/total nonaccrual loans
*R*8 = Charge-off real estate loans/total charge-off loans
*R*10 = Recovery real estate loans/total recovery loans

P-value (in the second row for each ratio) under HO: *Rho*=0

Source: The Authors

number in all ordinary least square (OLS) models never reaches 10, while the critical value is 30. Among the variance inflation factors (VIF) in all OLS models, the greatest VIF is 2.1 which is well below the critical value of 10. However, heteroskedastic problems occur in two of the OLS models (Exhibit 3). The results of the regressions with a correction for heteroskedasticity are reported in Model 3-Het and Model 4-Het (Exhibit 3).

The results from both the annual and average ratio approaches indicate that the ratio of nonfarm and nonresidential loans/total loans, *R*5, is significantly positive in all models (Exhibits 3 and 4). These results appear to be very reasonable for two reasons. First, commercial real estate loans were generally considered to be high-risk loans during the sample period (1986–1991) in which the commercial real estate values declined dramatically. Compared to the other types of mortgages, commercial mortgages contributed the most to the sensitivity of bank stock returns to real estate. Second, the real estate return

Exhibit 3
The Impact of Various Real Estate Loan Composition/Quality Measures on Bank Return Sensitivity Using Average Ratios and MREITW (Mortgage REIT Index)

Model	Intcept	*R*1	*R*2	*R*3	*R*4	*R*5	*R*6	*R*7	*R*8	*R*9	*R*10	No.	VIF	χ^2
1	.004	.005	−.073	.001	−.031	.016***						7.7	1.3	28
	(.04)	(.70)	(−1.20)	(.14)	(−1.28)	(2.77)								
2	−.010	.002	−.074	.001	−.029	.014**				.006	−.005	8.9	2.1	41
	(−.09)	(.34)	(−1.18)	(.20)	(−1.21)	(2.44)				(1.34)	(−.70)			
3-Het	−.004	.003	−.082*	−.001	−.033	.015**		.002				8.5	1.4	39
	(−.04)	(.29)	(−1.85)	(−.16)	(−1.14)	(2.20)		(.70)						
4-Het	.006	.006	−.065*	.002	−.034	.019**			−.002		.002	9.7	2.1	49
	(.50)	(.64)	(−1.71)	(.42)	(−1.19)	(1.93)			(−.72)		(.39)			
5	−.036						.005**							
	(−.35)						(2.17)							
6	−.035						.006*		−.001		.000	9.2	1.8	14
	(−.34)						(1.82)		(−.30)		(.06)			

*represents significance at the 10% level; **represents significance at the 5% level; ***represents significance at the 1% level

Het = Regression with the correction of heteroskedasticity
*R*1 = Average ratio of construction loans/total loans
*R*2 = Average ratio of farmland loans/total loans
*R*3 = Average ratio of one-to-four-family residential loans/total loans
*R*4 = Average ratio of multifamily residential loans/total loans
*R*5 = Average ratio of nonresidential loans/total loans
*R*6 = Average ratio of total real estate loans/total loans
*R*7 = Average ratio of past due real estate loans/total past due loans
*R*8 = Average ratio of nonaccrual real estate loans/total nonaccrual loans
*R*9 = Average ratio of charge-off real estate loans/total charge-off loans
*R*10 = Average ratio of recovery real estate loans/total recovery loans
No. = Highest condition number in the OLS models
VIF = Highest variance inflation in the OLS models
χ^2 = *Chi*-square value in the test of first and second moment specification

t-values are in parentheses.

Source: The Authors

proxy used in the three-index model to estimate real estate return *betas* is an index of mortgage REIT returns.

In Models 3-Het and 4-Het (Exhibit 3), the coefficients for *R*2, the ratio of farmland loans/total loans, are significantly (at the 10% level) negative. Thus, the results suggest that farmland loans could play a diversification role in terms of reducing the real estate return sensitivity of bank stocks. However, farmland loans are usually made in rural areas and rural areas are usually not significantly affected by the changes in commercial or residential real estate markets.

The coefficients for *R*6, the ratio of total real estate loans/total loans, are significantly (at the 10% level or greater) positive in Models 5 and 6 (Exhibit 3). The results clearly

Exhibit 4
The Impact of Various Real Estate Loan Composition/Quality Measures on Bank Return Sensitivity Using Annual Ratios and MREITW (Mortgage REIT Index)

Model	Intcept	*R*1	*R*2	*R*3	*R*4	*R*5	*R*6	*R*7	*R*8	*R*9	*R*10	No.	VIF	χ^2
1	.081	−.006	−.038	−.001	.004	.008*						7.2	1.3	27
	(1.07)	(−1.08)	(−.89)	(−.36)	(.25)	(1.67)								
2	0.74	−.005	−0.42	−.001	.004	.009*				−.004*	.005*	8.1	1.4	37
	(.96)	(−.99)	(−.99)	(−.31)	(.24)	(1.88)				(−1.86)	(1.70)			
3	.08	−.005	−0.37	−.001	.004	.008*		−.001				7.9	1.4	33
	(1.05)	(−.97)	(−.87)	(−.22)	(.27)	(1.72)		(−.43)						
4	.067	−.005	−.038	−.001	.003	.008*			−.001		.003	8.4	1.6	35
	(.88)	(−.93)	(−.88)	(−.20)	(.20)	(1.65)			(−.70)		(1.14)			
5	.053						.001							
	(.71)						(.70)							
6	.039						.002		−.001		.004	7.9	1.5	11
	(.51)						(.71)		(−.62)		(1.28)			

*represents significance at the 10% level

*R*1 = Average ratio of construction loans/total loans
*R*2 = Average ratio of farmland loans/total loans
*R*3 = Average ratio of one-to-four-family residential loans/total loans
*R*4 = Average ratio of multifamily residential loans/total loans
*R*5 = Average ratio of nonresidential loans/total loans
*R*6 = Average ratio of total real estate loans/total loans
*R*7 = Average ratio of past due real estate loans/total past due loans
*R*8 = Average ratio of nonaccrual real estate loans/total nonaccrual loans
*R*9 = Average ratio of charge-off real estate loans/total charge-off loans
*R*10 = Average ratio of recovery real estate loans/total recovery loans
No. = Highest condition number in the OLS models
VIF = Highest variance inflation in the OLS models
χ^2 = *Chi*-square value in the test of first and second moment specification

t-values are in parentheses.

Source: The Authors

suggest that changes in total real estate loans can significantly influence the sensitivity of bank stocks to real estate returns.

The results from Model 2 (Exhibit 4) show a significantly (at the 10% level) negative coefficient for *R*9, the ratio of charge-off real estate loans/total charge-off loans, and a significantly (at the 10% level) positive coefficient for *R*10, the ratio of recovery real estate loans/total recovery loans. The results suggest that an increase in the charge-off real estate loans/total charge-off loans ratio has a negative impact on the real estate return sensitivity. Since such an increase means a decrease in the total amount of real estate loans, a reduction in bank real estate return sensitivity seems reasonable. On the other hand, an increase in the recovery real estate loans causes the expansion of total real estate loans, which raises bank real estate return sensitivity.

Exhibit 5
The Impact of Various Real Estate Loan Composition/Quality Measures on Bank Return Sensitivity Using Average Ratios and EREITW (Equity REIT Index)

Model	Intcept	*R*1	*R*2	*R*3	*R*4	*R*5	*R*6	*R*7	*R*8	*R*9	*R*10	No.	VIF	χ^2
1	−.063	−.007	−.014	−.001	−.025	.017*						7.7	1.3	25
	(−.46)	(−.82)	(−.18)	(−.12)	(−.80)	(2.35)								
2	−.035	−.005	−.004	−.001	−.026	.019***				−.005	.001	8.9	2.1	29
	(−.25)	(−.51)	(−.04)	(−.09)	(−.83)	(2.55)				(−.99)	(.06)			
3	−.058	−.006	−.008	.000	−.024	.018**		−.001				8.5	1.4	32
	(−.42)	(−.61)	(−.10)	(.03)	(−.74)	(2.37)		(−.42)						
4	−.029	−.003	.022	.002	−.031	.026***			−.005		−.004	9.7	2.1	32
	(−.21)	(−.29)	(.26)	(.39)	(−.97)	(2.87)			(−1.53)		(−.56)			
5	−.109						.004							
	(−.81)						(1.29)							
6	−.086						.007		−.002		−.004	9.2	1.8	7
	(−.62)						(1.60)		(−.79)		(−.56)			

*represents significance at the 10% level; **represents significance at the 5% level; ***represents significance at the 1% level

Het = Regression with the correction of heteroskedasticity
*R*1 = Average ratio of construction loans/total loans
*R*2 = Average ratio of farmland loans/total loans
*R*3 = Average ratio of one-to-four-family residential loans/total loans
*R*4 = Average ratio of multifamily residential loans/total loans
*R*5 = Average ratio of nonresidential loans/total loans
*R*6 = Average ratio of total real estate loans/total loans
*R*7 = Average ratio of past due real estate loans/total past due loans
*R*8 = Average ratio of nonaccrual real estate loans/total nonaccrual loans
*R*9 = Average ratio of charge-off real estate loans/total charge-off loans
*R*10 = Average ratio of recovery real estate loans/total recovery loans
No. = Highest condition number in the OLS models
VIF = Highest variance inflation in the OLS models
χ^2 = *Chi*-square value in the test of first and second moment specification

t-values are in parentheses.

Source: The Authors

The other five ratios, *R*1 (construction and development loans/total loans), *R*3 (one-to-four-family residential loans/total loans), *R*4 (five-or-more-family residential loans/total loans), *R*7 (past due ninety-plus-day real estate loans/total past due loans), and *R*8 (nonaccrual real estate loans/total nonaccrual loans), have insignificant coefficients. Thus, it appears that these categories of real estate loans do not have a significant impact on the sensitivity of bank stocks to composition/quality of mortgage loan portfolios for these categories.

The major findings using both the annual and average ratio approaches are consistent with each other. That is, both approaches find significantly positive coefficients for nonresidential real estate loans (*R*5). However, there are also some inconsistent results from the two approaches. The significantly negative coefficients for farmland loans (*R*2)

Exhibit 6
The Impact of Various Real Estate Loan Composition/Quality Measures on Bank Return Sensitivity Using Annual Ratios and EREITW (Equity REIT Index)

Model	Intcept	*R*1	*R*2	*R*3	*R*4	*R*5	*R*6	*R*7	*R*8	*R*9	*R*10	No.	VIF	χ^2
1-Het	.258	−.003	−.017	−.006	−.132	.004						7.2	1.3	33
	(1.54)	(−.21)	(−.16)	(−.91)	(−.09)	(.33)								
2	.004	.012	.023	−.000	.010	−.004				.000	.002	8.1	1.4	42
	(.03)	(1.44)	(.33)	(−.06)	(.41)	(−.45)				(.02)	(.39)			
3	.004	.014	.030	.002	.012	−.001		−.002				7.9	1.4	37
	(.03)	(1.63)	(.42)	(.31)	(.46)	(−.11)		(−1.08)						
4	.002	.013	.027	.000	.010	−.002			−.001		.002	8.4	1.6	38
	(.02)	(1.50)	(.38)	(.09)	(.40)	(−.26)			(−.49)		(.51)			
5	.040						.001							
	(.32)						(.38)							
6	.032						.002		−.001		.002	7.9	1.5	10
	(.26)						(.56)		(−.56)		(.38)			

*represents significance at the 10% level

*R*1 = Average ratio of construction loans/total loans
*R*2 = Average ratio of farmland loans/total loans
*R*3 = Average ratio of one-to-four-family residential loans/total loans
*R*4 = Average ratio of multifamily residential loans/total loans
*R*5 = Average ratio of nonresidential loans/total loans
*R*6 = Average ratio of total real estate loans/total loans
*R*7 = Average ratio of past due real estate loans/total past due loans
*R*8 = Average ratio of nonaccrual real estate loans/total nonaccrual loans
*R*9 = Average ratio of charge-off real estate loans/total charge-off loans
*R*10 = Average ratio of recovery real estate loans/total recovery loans
No. = Highest condition number in the OLS models
VIF = Highest variance inflation in the OLS models
χ^2 = *Chi*-square value in the test of first and second moment specification

t-values are in parentheses

Source: The Authors

and significantly positive coefficients for total real estate loans (*R*6) are found only when using the average ratio approach. In contrast, the significantly negative coefficient for charge-off real estate loans (*R*9) and significantly positive coefficient for recovery real estate loans (*R*10) are present only when using the annual ratio approach. The results may partially reflect the trade-off between the quality of the real estate return *beta* estimates and the amount of information about real estate loan ratios. The annual ratio approach provides more information. However, the quality of the annual real estate *betas*, due to the reduced number of observations available for the estimation, may affect the results. That is, the number of observations used in estimating the annual *beta* is fifty-two (weekly data),[2] which is much smaller than the 311 weekly observations used in estimating the *betas* over the entire sample period for each BHC. Thus, the quality of the annual *beta* estimates may not be as good as the overall *beta* estimates, due to the smaller number of observations available. Poor quality of annual *beta* estimates could potentially

cause a decline in the significance of the ratio coefficients, even though more information is provided by the annual ratios than the average ratios.

The use of the equity REIT return index as the real estate return proxy does not significantly change the results. Exhibit 5 shows that the coefficients for *R*5 in all models are significant at the 1% and 5% levels. However, when annual data is used, none of the coefficients is significant (Exhibit 6). The results indicate that all types of real estate loans, except for the nonfarm and nonresidential loans (*R*5), are less sensitive to the equity REIT return index than the mortgage REIT return index.

Conclusions

The following conclusions are based on the results discussed previously.

- Using the mortgage REIT return index, the type of real estate loan (mortgage portfolio composition) has a significant impact on bank real estate return sensitivity. Specifically, the nonresidential real estate loans (commercial mortgages) contribute the most to the sensitivity of bank stocks to real estate returns. On the other hand, farmland loans have a negative impact on bank real estate return sensitivity. Thus, farmland loans could perform a diversification role in terms of reducing bank real estate return sensitivity.
- Because of the potential diversification role that could be performed by the farmland loans, the quantity of real estate loans alone cannot significantly affect the sensitivity of bank stocks to real estate returns.
- The quality of mortgage portfolios can significantly change bank stock real estate return sensitivity. Furthermore, when using mortgage REIT returns, charge-off real estate loans have a negative impact on the sensitivity of bank stock returns to real estate returns. However, an increase in recovery real estate loans increases bank real estate return sensitivity. The past due (ninety-plus-day) real estate loans and nonaccrual real estate loans do not have a significant impact on bank real estate return sensitivity.
- The results from the use of the annual ratios and average ratios are similar for the mortgage REIT return index, but not for the equity REIT return index.
- Nonresidential real estate loans are sensitive to changes in the return indexes for both mortgage REITs and equity REITs. Other types of real estate loans have no significant response to the changes of equity REIT returns.

Appendix
List of Bank Holding Companies (1986–1991)

Name	Total Assets (1991)	Real Estate *Betas*
1. Amsouth Bancorporation	9486 millions	.01981
2. Central Bancshares South Inc	6134	.28983
3. Southtrust Corp	10,158	.27210
4. First Alabama Bancshares Inc	6763	.34280
5. Valley National Corp AZ	10,686	−.02381
6. Worthen Baning Corp	2441	−.09104
7. City National Corp	4567	−.06258

Name	Total Assets (1991)		Real Estate *Betas*
8. SC Bancorp	462		.05374
9. First Interstate Bancorp	4892		.34007
10. Guardian Bancorporation LA	729		−.80015
11. CVB Financial Corp	560		−.10677
12. BSD Bancorp Inc	425		−.24883
13. BankAmerica Corp	115,509		−.04146
14. Well Forgo & Co New	5354		.15929
15. Pacific Western Bancshares	1120		−.14677
16. Redwood Empire Bancorp	235		.27578
17. United Banks Colorado Inc	6330	(1990)	.39488
18. Eldorado Bancorp CA	355		−.15786
19. Citytrust Bancorp Inc	2115	(1990)	1.60424
20. Affiliated Bankshares Colo Inc	2912		.13923
21. Colorado National Bankshares Inc	3044		.37439
22. Shawmut National Corp	22,832		.81974
23. Northeast Bancorp Inc	3493		.80527
24. James Madison LTD	866	(1990)	2.33867
25. Wilmington Trust Corp	4063		.00070
26. Riggs National Corp Washington DC	5577		.68279
27. Barnett Banks Inc	32,770		.34617
28. Southeast Banking Corp	13,390	(1990)	.22173
29. First Florida Banks Inc	5770		.60438
30. Bank South Corp	4472		.05770
31. Suntrust Banks Inc	34,552		.18318
32. Synovus Financial Corp	4070		.09122
33. First City Bancorporation TX Inc	1034		.56407
34. Bancorp Hawaii Inc	11,409		.05415
35. First Hawaiian Inc	6511		−.09941
36. West One Bancorp	5417		.06413
37. Magna Group	3777		.08850
38. Continental Bank Corp	24,008		.16583
39. First Chicago Corp	48,963		.21961
40. Northern Trust Corp	13,192		−.05202
41. Suburban Bancorp Inc IL	1066		−.16027
42. INB Financial Corp	6624		.33879
43. Merchants National Corp	5824		.05623
44. Banks Iowa Inc	2715		.06350
45. Bank New England Corp	29,503	(1989)	−.61100
46. Fourth Financial Corp	4163		.43178
47. Citizens Fidelity Corp	6435		.75649
48. Liberty National Bancorp Inc	6340		.00658
49. Mid America Bancorp	981		−.07447
50. Premier Bancorp Inc	3852		.30183
51. First Commerce Corp New Orleans	5009		.31954
52. Hibernia Corp	5818		.25201
53. Whitney Holding Corp	2858		.37555
54. Baltimore Bancorp	3214		.28246
55. Mercantile Bankshares Corp	5217		−.03686
56. MNC Financial Inc	17,461		−.01855
57. Bank of Boston Corp	32,700		.20874
58. Baybanks Inc	9515		−0.12677
59. Star Banc Corp	6295	(1990)	−.07053
60. Multibank Financial Corp	2632		.30505

Name	Total Assets (1991)		Real Estate *Betas*
61. Comerica Inc	1452		−.03979
62. Manufacturers National Corp	13,544		.03510
63. NBD Bancorp Inc	29,513		−.07493
64. Michigan National Corp	10,717		−0.05553
65. Old Kent Financial Corp	8826		2.00012
66. First of America Bank Corp	16,755		.20449
67. Security Bancorp Inc MI	2736		.19792
68. First Bank Systems Inc	18,301		−.04434
69. Norwest Corp	3850		.23082
70. Deposit Guaranty Corp	5066		.53996
71. Trustmark	3878		.13932
72. Commerce Bancshares Inc	6774		.17439
73. United Missouri Bancshares Inc	4692		.09269
74. Boatmens Bancshares Inc	17,674		−.08361
75. Mercantile Bancorporation Inc	8115		−.07838
76. Firstier Financial Inc	3004		.13539
77. Midlantic Corp	18,170		.82077
78. Citizens First Bancorp	2506		1.87754
79. First Fidelity Bancorporation NE	29,110	(1990)	.21808
80. National Community Banks Inc	4021		.07985
81. UJB Financial Corp	13,384		.56508
82. Interchange Financial SVCS Corp	400		−.01402
83. HUBCO Inc	673		.33314
84. Sunwest Financial Services Inc	3406		.08847
85. Keycorp	23,156		.23475
86. First Empire State Corp	9171		.37947
87. North Fork Bancorporation NY Inc	1778		.41252
88. Bankers Trust NY Corp	63,959		−.02971
89. Manufacturers Hanover Corp	61,530	(1990)	.10020
90. Chase Manhattan Corp	98,197		.34129
91. Chemical Banking Corp	138,930		.23069
92. Citicorp	216,922		−.11303
93. Morgan JP & Co Inc	103,468		−.17309
94. Republic New York Corp	31,221		−.08971
95. Sterling Bancorp	512		.37170
96. United States Trust Corp	2923		−.07838
97. Community National Bancorp Inc	405	(1990)	−.32933
98. First Union Corp	46,085		.21160
99. First Citizens Bancshares Inc NC	5458		.09344
100. Centura Banks Inc	2626		.32579
101. BB & T Financial Corp	6229		.06746
102. First Bancorporation Ohio Inc	3766		.24178
103. Fifth Third Bancorp	8819		.12403
104. State Street Boston Corp	15,046		−.17359
105. Ameritrust Corp	10,181		.51336
106. National City Corp	24,170		.08700
107. Society Corp	15,418		.11962
108. Banc One Corp	46,198		−.00197
109. Huntington Bancshares Inc	12,333		.27974
110. Bancoklahoma Corp	1802	(1990)	.67932
111. United States Bancorp OR	18,900		−.07740
112. Dauphin Deposit Corp	3612		.28705
113. Corestates Financial Corp	21,694		.03210

Name	Total Assets (1991)		Real Estate *Betas*
114. Equimark Corp	3145		.12007
115. Integra Financial Corp	8876		.36522
116. Mellon Bank Corp	29,358		.09369
117. PNC Financial Corp	45,193		.10303
118. Meridian Bancorp Inc	11,354		.41545
119. Fleet Norstar Financial Group	45,597		.09982
120. South Carolina National Corp	6954		.09109
121. First Tennessee NATL Corp	7904		.15360
122. Union Planters Corp	3787		.27834
123. First American Corp TN	6378		.54799
124. Cullen Frost Bankers Inc	3104		.13805
125. First Security Corp DE	7015		.07879
126. Zions Bancorp	3646		−.24062
127. First Virginia Banks Inc	6119		.27265
128. C & S Sovran Corp	47,968		−.06446
129. Central Fidelity Banks Inc	6822		.32426
130. Crestar Financial Corp	11,828		.18698
131. Signet Banking Corp	11,265		.35489
132. Dominion Bankshares Corp	9711		.26357
133. Puget Sound Bancorp	4883		.09430
134. Key Centurion Bancshares	3054		.01161
135. Valley Bancorporation	3976		−.14964
136. Firstar Corp New	12,309		.07016
137. Marshall & Illsley Corp	7628		.08173
138. Banponce Corp	8780		.25393
139. Citizens & Southern Corp GA	24,804	(1990)	.00847
140. Equitable Bancorporation	5251	(1989)	.06807
141. National Bancshares Corp TX	208		−.22950
142. First Pennsylvania Corp	6607	(1989)	−.03613
143. Florida National Banks FL Inc	7898	(1989)	.68118
144. La Jolla Bancorp	547	(1989)	−.29426
145. Alliance Bancorporation	803	(1988)	.78535
146. First Maryland Bancorp	8946		.29415
147. Horizon Bancorp	362		.32149
148. M Corp	401		1.9669
149. Texas American Bancshares Inc	4383	(1988)	.76887
150. Allied Bancshares Inc	7996	(1987)	.86475
151. Centerre Bancorporation	5247	(1987)	−.12713
152. Fidelcor	11,111		−.36347
153. First Kentucky National Corp	5876		−.33433
154. First Wyoming Bancorporation	875	(1987)	.11304
155. Irving Bank Corp	23.534	(1987)	−.37551
156. Marine Corp	1177	(1990)	−.35695
157. Shawmut Corp	11,518		−.13289
158. Texas Commerce Bancshares Inc	18,216	(1990)	−1.21804
159. Citizens & Southern Corp	28,994	(1989)	−.10363
160. General Bancshares Corp	234	(1986)	.01285
161. Third National Corp	5808	(1990)	.51018
162. American Fletcher Corp	4560	(1986)	−1.31617
163. American Security Corp	5692	(1990)	.62425
164. First National Corp CA	584	(1990)	−.10096
165. Marine Midland BKS Inc	20,107	(1990)	−.36793
166. Norstar Bancorp Inc	12,517	(1987)	2.45648

Notes

[1]The list of 166 BHCs is shown in the Appendix.

[2]There were only fifty-one observations available for 1986.

References

Anderson, D. R. and M. Weinrobe, Mortgage Default Risks and the 1971 San Fernando Earthquake, *AREUEA Journal,* 1986, 14, 110–35.

Campbell, T. S. and J. K. Dietrich, The Determinants of Default in Insured Conventional Residential Mortgage Loans, *Journal of Finance,* 1983, 38, 1569–81.

Flannery, M. J. and C. M. James, The Effect of Interest Rate Changes of Common Stock Returns of Financial Institutions, *Journal of Finance,* 1984, 39, 1141–53.

Furstenberg, G. M. and R. J. Green, Estimation of Delinquency Risk for Home Mortgage Portfolios, *AREUEA Journal,* 1974a, 2, 375–84.

——, Home Mortgage Delinquencies: A Cohort Analysis, *Journal of Finance,* 1974b, 24, 1545–48.

He, L. T., N. Myer and J. R. Webb, The Sensitivity of Bank Stock Returns to Real Estate, *Journal of Real Estate Finance and Economics*, 1996, 12, 203–20.

Kmenta, J., *Elements of Econometrics,* New York: Macmillan, 1986.

Mei, J. and A. Saunders, Bank Risk and Real Estate: An Asset Pricing Perspective, working paper, New York University, 1991.

National Association of Real Estate Investment Trusts, Inc., *REIT Sourcebook: A Complete Guide to the Modern Real Estate Investment Trust Industry,* Washington D.C.: NAREIT, 1992.

White, H., A Heteroskedasticity–Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, *Econometrica,* 1980, 48, 817–38.