Southern Business Review

Volume 15 | Issue 2 Article 8

September 1989

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Introduction

On what do bank equity returns depend? Market model studies of most firms relate equity returns solely to a market index. However, commercial banks are so closely identified with financial variables that it might be expected that interest rate changes would affect bank equity returns as well.

A number of studies in recent years have attempted to measure the effect of interest rate movements on bank stock returns. Flannery and James (1984) employ a two index market model to demonstrate that the returns for a portfolio of commercial banks are inversely related to unexpected changes in a variety of interest rate measures. Sweeney and Warga (1986) found that the returns of both public utilities and commercial banks are inversely related to unexpected rate changes. They also found that the sensitivity of a firm's returns to interest rate changes may be priced by the market. That is, they found evidence that equilibrium firm returns are positively related to firm interest sensitivity.

While these studies provide valuable insights regarding the effects of interest rate changes on commercial bank returns, questions remain. Both of the studies cited above employ the two index market model; that is, both studies regress firm or portfolio returns against the returns of a market index and unexpected changes in a single interest rate. The use of a single rate represents an implicit assumption that either the slope of the term structure of interest rates is constant over time or the equity returns are unrelated to unexpected changes in the term structure of interest rates. The use of a single rate also implies that unexpected changes in the structure of risk premia among interest rates (the differences in required yields among securities of differing risk) have no effect on bank equity returns.

However, Fogler, Kose, and Tipton (1981) and Roll and Ross (1984) have recently presented empirical evidence which demonstrates that, on average, firm returns generally *are* related to both term structure and risk premia factors. The unexamined issue is whether bank equity returns are also affected by changes in the term structure and changes in risk premia. This is an important topic because the sensitivity of bank equity returns to these factors indicates the degree to which banks can insulate or hedge themselves against changes in the structure of interest rates. This is the issue addressed in this paper.

Specifically, the purpose of this paper is to determine whether the equity returns for a portfolio of commercial banks are significantly related to four factors: the market index, unexpected changes in the level of interest rates, unexpected changes in the slope of the term structure of interest rates, and

unexpected changes in market risk premia. The methodology and data are described in the following section of the paper, followed by an examination of the results, and a discussion of the implications of these results.

Methodology and Data

As with Fogler et al., (1981), Flannery and James (1984), and Sweeney and Warga (1986), the basic equation to be estimated is the familiar market model adjusted by the inclusion of interest rate variables. Specifically, the following equation is estimated using OLS:

$$r_{it} = a_i + b_{1i}R_{mt} + b_{2i}L_t + b_{3i}S_t + b_{4i}A_t + e_t \qquad (1)$$

where r_{it} is the common stock return for bank i in month t, R_{mt} is the return for the market index for month i, L_t is the unexpected change in the level of interest rates for month i (proxied by the change in the 90 day Treasury Bill rate), S_t is the unexpected change in the slope of the term structure of interest rates during month i (proxied by the change in the difference between the 30 year U.S. Government Bond rate and the 90 day Treasury Bill rate), and A_t represents the unexpected change in market risk aversion during month i (proxied by the change in the difference between the average rate on AAA rated corporate bonds and the long term government bond rate). These interest rate variables were chosen because they were the measures used by Roll and Ross (1984) and thus allow the results of this study to be compared to their findings.

Because market returns could be significantly correlated with these interest rate measures (thus posing significant problems of multicollinearity), the interest rate measures are first regressed against the market return. The errors of these regressions thus represent interest rate changes uncorrelated with the equity market (the interest rate changes orthogonal to market returns). These uncorrelated interest changes are the interest rate changes used in equation (1).

A common criticism of such models as equation (1) (see Brennan (1981)) is that such multi-factor models may suffer from an omitted-variables problem leading to biased coefficient estimates. In order to determine whether the above equation is misspecified and whether significant factors are omitted, a variation of the regression specification error test (RESET) proposed by Ramsey (1969) and developed by Thursby and Schmidt (1977) and Thursby (1981) is employed. Assume the model to be tested for specification error is:

$$Y = XB + u \qquad (2)$$

RESET tests the significance of C in the augmented regression:

$$Y = XB + ZC + u \qquad (3)$$

where Z is a matrix of test variables such as powers of the independent variables and:

$$G = AY = Au \tag{4}$$

where:

$$A = (Z^{1}MZ)^{-1}Z^{1}M \tag{5}$$

and:

$$M = I - X(X^{1}X)^{-1}X^{1} \tag{6}$$

If the model is correctly specified, E(C) = O. Ramsey (1969) has shown that the test statistic for this procedure has an F distribution with the numerator of the F-statistic having degrees of freedom equal to the number of explanatory powers and denominator of the F-statistic having degrees of freedom equal to the number of observations minus the number of explanatory variables.

Using simulation, Thursby (1977) found that the RESET procedure was best able to discern misspecification when the second, third, and fourth powers of each explanatory variable were included in the augmented regression. Therefore, the augmented regression tested by the RESET procedure in this study includes four proposed market factors and their second, third, and fourth powers.

The returns data consist of the monthly returns of 24 commercial banks from January 1974 through December 1985 (see Exhibit 1). These banks represent all banks with complete returns data in the center for research in Securities Prices (CRSP) monthly master file for the estimation period. Our proxy for the market returns was the monthly returns for a value weighted index of all stocks listed on the New York Stock Exchange. Monthly U.S. Treasury Bill rates, U.S. Government Bond Rates, and corporate bond rates were collected from Business Conditions Digest.

Results

The results of estimating equation 1 for an equally weighted portfolio of 24 commercial banks are presented in Table 1. An equally weighted portfolio was used rather than a value weighted portfolio so that the large money center banks would not dominate the findings. (See Exhibit 1 for a complete listing of the sample banks.) Several results emerge. The model explains a significant proportion of the variance of portfolio returns over the January 1978 - December 1985 period. The model R^2 is greater than .66. Three of the four factor coefficients are also significant. Specifically, the coefficients associated with the market index, the change in Treasury Bill rates, and the change in the difference between long- and short-term government interest rates are all significant. The coefficient associated with a change in market risk aversion (the change in the difference between long-term government and corporate rates) is not found to be significant for the portfolio returns.

Exhibit 1—Sample Banks

Bank of Virginia
Bank America Corp.
CBT Corp.
Chase Manhattan Corp.
Chemical Corp.
Citicorp
Continental Illinois
Crocker
Equimark
First Bank System
First City Bancorp.
Interfirst
First National State Bancorp.
First United Bancorp.
First Virginia Banks
First Wisconsin Corp.
General Bancshares
Harris Bancorp Inc.
Key Banks
NCNB Corp.
Republic of Texas Corp.
Southeast Banking Corp.
Texas American Bancshares
Union Commerce Corp.

The signs of the coefficients appear reasonable, given the results of other studies. The coefficient associated with the market index, the bank portfolio's "beta," is .927. This indicates that the bank portfolio has slightly less systematic risk than the market. This beta value is somewhat larger than the beta values reported by either Fogler, Kose, and Tipton (1981) or Flannery and James (1984). For example, the beta reported in the Flannery and James study has a value of .56. The difference in beta values between this study and previous one is probably the difference in the time period examined. Previous studies look at bank returns during the 1970's while this study investigates bank returns predominantly during the 1980's — a period of great regulatory reform for financial institutions.

The negative coefficients associated with the proxies for unexpected changes in the level and term structure corroborate and extend the findings of Flannery and James (1984) and Sweeney and Warga (1986). These results suggest that, on average (since the portfolio coefficients represent the average of the coefficients of the individual banks), commercial banks have longer maturity assets than liabilities. Therefore, an increase in the level or the slope of the term structure of interest rates should diminish the market value of banks' assets to a greater degree than banks' liabilities.

Table 1 — Results of Estimating Equation 1 for an Equally Weighted Portfolio of 24 Commercial Banks (January 1978 - December 1985)

$R^2 = .66$
Intercept $= -.002$
RESET F-statistic $= .354$

Independent Variable	Coefficient
Market Index	.927*
Unexpected Change in the Level of Interest Rates	−.039*
Unexpected Change in the Term Structure of Interest Rates	−.049*
Unexpected Change in Risk Premia	−.020

* = significant at the .0001 level

The magnitudes of these coefficients indicate that the sensitivity of equity returns to changes in the level or slope of the term structure is very strong. Literally, these coefficients imply that an unexpected increase in the Treasury Bill rate of 1% will result in a 3.96% decrease in bank equity value, and that a 1% increase in the difference between the long-term and short-term government bond rate will decrease equity value by 4.9%.

Although the coefficient associated with the proxy for changes in market risk aversion is negative, as a priori reasoning would suggest, the fact that this coefficient is not significant is somewhat surprising. Given that a significant proportion of the liabilities of most commercial banks are guaranteed by the Federal Deposit Insurance Corp., one might presume that an unexpected increase in the risk premia demanded by the market should decrease the market value of bank assets more than the market value of bank liabilities, and thus diminish the value of the bank's equity. Therefore, it might be expected that increases in the value of the risk proxy would negatively affect bank equity returns to a significant degree.

Table 1 also indicates that the F-statistic associated with the Thursby test for model specification is not significant. The Thursby procedure therefore implies that no significant factors have been omitted from equation 1. While this finding may require further research, it is quite important in that it implies that bank equity returns, on average, may only be significantly related to these factors: the market index, the level of interest rates, and the slope of the term structure of interest rates.

The results of estimating equation 1 for each of the 24 commercial banks individually are presented in Table 2. Generally, the individual results tend

to reinforce the portfolio findings. The equity returns for all of the sample banks are significantly and positively related to the market factor (although the variation in "beta" is large, ranging from roughly .56 to 1.36). The equity returns of all but six banks are significantly and negatively related to the term structure level and term structure slope variables.

Table 2 — The Results of Estimating Equation 1 for Each Individual Commercial Bank in the 24 Bank Sample (January 1978 - December 1985)

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
R_2	.337	.099	.136	.491
a1	−.001	.001	−.021	.008
b1i	.882**	.218	.580	1.420
b2i	−.041**	.021	−.075	.019
b3i	−.051**	.033	−.118	.035
b4i	−.039*	−.067	−.300	.035

* significant at the .01 level
** significant at the .0001 level

There are also significant differences between the individual and portfolio results. The major difference is that while the coefficient associated with risk aversion is not significant for the portfolio estimation of equation (1), this coefficient is significant for a majority of the individual bank regressions. In other words, although bank equity returns, on average, might not be significantly related to changes in market risk aversion, the equity returns of many individual banks are related to this factor. This finding implies that the market perceives that commercial banks differ somewhat widely in risk.

Another difference between the portfolio and individual findings is that the model explains less of the variance of individual bank returns, on average, than it does the variance of portfolio returns. The average R^2 for the estimation of equation 1 for individual banks was roughly .34. This result is not surprising in that it might be expected that the use of average or portfolio returns would filter out much of the noise in the returns data.

Table 2 also indicates that there is a somewhat wide variance in the sensitivity of bank equity returns to changes in the level and slope of the term structure of rates. The respective standard deviations are .021 and .033. This finding implies that the market believes that banks differ significantly in the duration or maturity of the assets and liabilities they hold. Thus it appears that the market discerns wide variations in "gaps" (rate sensitive assets - rates sensitive liabilities) among commercial banks.

Summary

Several recent studies have found that bank equity returns are significantly related to unexpected changes in the level of interest rates as well as the market index. The purpose of this study was to determine whether the equity returns of a sample of commercial banks are significantly related to unexpected changes in the slope of the term structure of interest rates and unexpected changes in market risk aversion as well as these other two factors. This study finds a significant negative relationship, on average, between changes in the slope of interest rates and bank equity returns. This represents evidence that the market believes, on average, the duration or maturity of bank assets is significantly greater than the duration of bank liabilities.

The study also finds that the mean equity returns for a portfolio of commercial banks are not significantly related to changes in market risk aversion. However, the study finds that the equity returns for a majority of the individual sample banks are significantly and negatively related to changes in market risk aversion. These results thus indicate that the market may believe that commercial banks differ significantly in the riskiness of their asset or liability portfolios.

Additionally, this study uses the regression specification error test (RESET) developed by Ramsey (1969), Thursby and Schmidt (1977), and Thursby (1981) in order to determine whether any factors relevant to the pricing of commercial bank equities were omitted from the model tested. This procedure failed to reject the null hypothesis of correct model specification. Thus, the hypothesis that bank equity returns are significantly related to the following three factors is not rejected: the market index, the level of the term structure of interest rates, and the slope of the term structure of interest rates. Finally, the study finds that commercial banks differ significantly in their sensitivity to changes in the structure of interest rates.

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SOUTHERN BUSINESS REVIEW
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