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Risk and Return in Banking: Evidence from Bank Stock Returns

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In this paper, I investigate the behavior of bank holding company stock returns from 1979 to 1990 in order to determine if bank risk has increased in recent years. Simple statistics on total volatility of returns indicate that the variance of bank stock returns rose in the latter part of the 1980s relative to earlier periods and to other stock and bond investments. In the context of equilibrium asset pricing models, I find that bank stock return covariance with respect to overall stock market returns increased during the 1980s while the sensitivity of bank stocks to returns on long-term debt securities declined. I also divide the sample by bank size and find that stocks of larger banks exhibited more stock market risk than smaller banks in the latter part of the 1980s, while no banks exhibited any statistically significant interest rate risk in the late 1980s.

There is currently a widespread perception that the U.S. banking system has become riskier in the past several years. The large number of bank failures, negative media coverage of the industry, and the rhetoric of legislative efforts in Washington to restructure the banking system all have contributed to this perception. Moreover, the legacy of the savings and loan crisis serves as a constant reminder of the excessive risks that some U.S. financial institutions undertook in the 1980s.

Industry observers have identified a number of factors that are potential causes of this apparent increase in bank risk. The usual list of suspects includes deregulation of financial markets, increased competition in banking, and financial innovation. The cause of any increased risk in banking probably will be a subject of debate for some time. Nevertheless, it is instructive to investigate the recent behavior of bank risk to determine if the public perception of greater risk is justified and whether any changes in risk have occurred in a systematic way. In this paper, I conduct such an investigation.

As a measure of bank risk, I consider the volatility of bank stock returns. Ideally, a direct measure of bank asset risk might be preferred, but it is difficult to observe the risks associated with specific bank assets. The behavior of bank stocks provides a reasonable, and readily available, alternative. In the absence of regulation or deposit insurance, there is a direct relationship between asset risk and stock risk. This relationship is complicated by the presence of financial regulation and the deposit insurance system, but the risk associated with holding bank stocks is still informative about the risks to the banking system. Moreover, the current focus on increased capital requirements for banks makes understanding bank stock risk particularly relevant. Common stock comprises the largest portion of bank capital and thus the value of bank equity provides a good proxy for bank net worth.

In this paper, I use a time series, cross-section sample of large U.S. commercial bank holding companies to examine the behavior of bank stock returns over the period 1979 to 1990. I consider first the overall volatility of these returns. Then, drawing on theories of capital asset pricing, I consider the influence of different systematic risk factors on the behavior of U.S. banks' stock returns.

The results from this analysis indicate that the relationship of bank stocks to systematic sources of risk in the economy has changed significantly during the past several years. Certainly, some sources of bank equity risk increased during the 1980s. However, my analysis shows that other sources of stock return variability actually declined during this period. My results also indicate that there is considerable variation among the banks in the sample regarding their equity risk. For example, I separate the banks in the sample by asset size. I find that the sensitivity of stock returns of large banks to overall stock market risk has increased relative to that of smaller banks. An understanding of such cross-sectional variations may help to identify potential winners and losers arising from proposals to reform the banking system.

While the study of bank stock returns provides useful insights into changes in bank risk, it is important to recognize the limitations of these data. The variability of bank stock returns reflects the market's perception of the risks associated with all aspects of bank holding company activities. These include asset risks, default risks, charter value risks, the risks associated with the value of the deposit insurance guarantee, and so on. It is not possible to infer from these data what has happened to a particular aspect of bank risk, say for example, to the riskiness of bank assets. (For a study of bank asset risk, see Mark Levonian's paper in this issue of the *Review*). The results here identify how the systematic risk factors included in asset pricing models influence the market's perception of this amalgam of bank stock risks and how this perception is reflected in bank equity returns.

I. Related Literature

According to the capital asset pricing model (CAPM, Sharpe 1964 and Lintner 1965), the return on a firm's equity can be explained as a function of a single factor, namely, the return on the market portfolio of assets. In empirical applications of the CAPM, the proxy for this market return typically is taken to be a broad measure of stock market returns (such as the S&P 500, or the AMEX composite index). The CAPM splits asset risk into two components. The first, called market or systematic risk, represents that portion of asset risk that is related to the riskiness of the market portfolio. The second component is called residual, or nonsystematic, risk and is the portion of total asset risk that is unrelated to the market portfolio. Because an investor can eliminate the effects of nonsystematic risk by suitably diversifying his portfolio, the CAPM argues that the expected returns on individual assets reflect only their systematic risk.

Bank stocks have been a frequent object of analysis in studies of equity risk and returns. Banks are of particular interest to economists because of their role as financial intermediaries. This role is believed to make bank stocks especially sensitive to changes in interest rates. To test this hypothesis, a number of studies have extended the basic CAPM formulation to include a measure of returns on debt in addition to the return on the market portfolio of stocks. This "two-index model" was first proposed by Stone (1974), and variations of this model have been investigated in subsequent work by Martin and Keown (1977), Lloyd and Schick (1977), Lynge and Zumwalt (1980), Chance and Lane (1980), Flannery and James (1982, 1984a, 1984b), Beebe (1983), and Booth and Officer (1985). With the exception of the paper by Chance and Lane, these studies have found that bank stock returns exhibit sensitivity to interest rates over and above their sensitivity to stock market changes. Moreover, this sensitivity exceeds that shown by most nonfinancial firms, confirming the notion that the particular nature of bank assets and liabilities makes them especially sensitive to changes in interest rates.[1]

A number of studies have attempted to relate the market and interest rate sensitivities of bank stock returns to some aspect of bank balance sheet composition. Dietrich (1986), for example, argues that the estimated coefficients in the two-index model should depend on the balance sheet proportions of broad categories of bank assets and liabilities. He embeds this hypothesis into the two-index model and estimates portfolio composition effects on the risk factors. Dietrich finds that market risk, the estimated coefficient on the market portfolio of stocks, is most heavily influenced by lending activity, time deposits, and long-term debt relative to assets. Interest rate risk, he finds, is most affected by the proportion of time deposits in the balance sheet. While Dietrich's results suggest that balance sheet composition may be important in explaining the risk characteristics of bank stocks, his empirical results suffer from serious econometric problems. The asset and liability categories used in that study also are too broad to be of much practical use in identifying specific sources of bank risk.

In a similar avenue of research, Rosenberg and Perry (1981) consider the determinants of bank risk in a single-index CAPM. More specifically, they estimate the effects on systematic and residual risk of a large number of asset and liability ratios, operating characteristics, stock market variables, and regional indicators. These authors find that a number of their chosen indicators are significant determinants of bank risk. More interesting, they find that different indicators help to explain systematic and nonsystematic risk of bank stock returns. For example, size, dividend yield, equity capital, and the asset/long-term liability ratio all help to predict market-related risk. For residual risk, earnings variability and leverage are the most important determinants. Rosenberg and Perry suggest that bank risk can be predicted by focusing on a few significant indicators, and that efforts to understand bank risk should focus on understanding these aspects of bank behavior.

One weakness of the studies cited above is that they provide little theoretical justification for the particular empirical specifications used. A study by Flannery and James (1984a) relies on a firmer theoretical foundation for the analysis of bank risk and return. In this work, the authors test the so-called "nominal contracting hypothesis" (French, Ruback, and Schwert 1983) on a sample of bank and thrift stocks. This hypothesis suggests that a firm's holdings of nominal assets and liabilities affect its common stock returns through the redistributive effects of unanticipated inflation and unanticipated changes in expected inflation. More specifically, the nominal contracting hypothesis suggests that the interest rate sensitivity of a firm's stock will be larger the greater the amount of net nominal assets (that is, nominal assets minus nominal liabilities) and the longer the duration of those net nominal assets.

Flannery and James first estimate a two-index model of stock returns on a time series, cross-section sample of bank stocks. They then develop a proxy for the duration of a bank's net nominal assets and regress the estimated interest rate coefficients on this duration measure. Nominal asset duration is highly significant in explaining the size of the interest rate sensitivity of bank stock returns. Kwan (1991) extends this work by estimating the Flannery and James model simultaneously in a random coefficients framework. These studies confirm that the composition of a bank's balance sheet, here as measured by the duration of its net nominal assets, can influence the sensitivity of bank stock returns to changes in interest rates.

II. Current Modeling Approach

Two Models of Asset Pricing

As the discussion of the related literature shows, most researchers have employed a particular empirical model of capital asset prices in order to focus on some aspect of bank stock risk. Some debate persists among economists as to the "correct" specification to use for describing equity returns. In this paper, I investigate the behavior of bank stocks in the context of two different models of asset pricing: the single-index CAPM and a two-factor model.

The typical CAPM formulation is specified as follows:

$$(1) \qquad R_{jt} = \alpha_j + \beta_{Mj} R_{Mt} + \epsilon_{jt},$$

where R_{jt} is the expected excess holding period return on the equity of bank j in period t, R_{Mt} is the expected excess holding period return on the market portfolio of stocks in period t, β_{Mj} is a parameter to be estimated that represents the sensitivity of the stock of bank j to changes in the expected return on the market portfolio, α_j is another estimated parameter that indicates deviations from equilibrium pricing, and ϵ_{jt} is the residual left unexplained by the expected return on the market portfolio.[2]

The parameter β_{Mj} is a measure of the covariance of return on an individual stock with the return on the market portfolio of risky assets. It thus represents the sensitivity of that stock to systematic, or nondiversifiable, risk.[3] According to the CAPM, an "average" stock in the market portfolio will have a value of β_{Mj} equal to one. An asset with β_{Mj} greater than one carries above average nondiversifiable risk, and must provide a greater than average expected return in order to induce investors to hold it. The CAPM predicts that only nondiversifiable risk is rewarded by a higher expected return. Risk that is idiosyncratic to the individual stock, and can therefore be diversified away, is not associated in equilibrium with higher expected returns. The model thus predicts that the expected value of α_j is zero. Of course, realized or *ex post* values of α_j can differ from zero if new information affects the asset's price and return during the estimation period.

As mentioned in the previous section, the primary hypothesis underlying the CAPM is that the return on the market portfolio is a sufficient statistic to determine the return on individual assets. One implication of this model, therefore, is that no other variables should be significant in explaining asset returns. Empirically, this prediction often has not been supported, leading to asset pricing models in which additional or alternative factors have been included to capture missing influences on individual asset returns.

The two-factor model augments the CAPM by adding as an additional explanatory variable the expected return on a debt security. The logic behind this model, as first proposed by Stone (1974), is that investors have two general categories of assets to choose from: equity shares and debt securities. As a result, expected returns on both types of instruments should be relevant in setting the price of individual financial assets. This same type of two-factor model also can be derived more rigorously from Merton's (1973) intertemporal version of the CAPM, or from Ross's (1976) multi-factor arbitrage pricing theory. A number of tests of the two-factor model using stock returns of industrial companies found little significance for debt returns. However, stocks of companies in certain sectors, such as utilities and financial intermediaries, typically exhibit significant sensitivity to changes in returns on debt securities.

The two-factor model takes the form

$$R_{jt} = \alpha_j + \beta_{Mj}R_{Mt} + \beta_{Ij}R_{It} + \epsilon_{jt}, \tag{2}$$

where R_{It} is the expected excess holding period return on a selected debt security in period t, β_{Ij} is a parameter that captures the sensitivity of asset j to changes in the expected holding period return on debt, and the other variables and parameters are as defined in equation (1).[4]

Two modeling issues arise in empirical applications of the asset pricing equations (1) and (2). First, time-series regressions of these equations imply that the estimated coefficients should be constant over time. Evidence suggests, however, that estimated βs exhibit considerable temporal variation. Moreover, efforts to relate the estimated coefficients to balance sheet composition variables suggest that these coefficients will change with changes in the asset/liability mix of banks. Recent evidence by Kane and Unal (1988) using a switching regression methodology and by Kwan (1991) in the context of a random coefficients framework confirms the nonstationarity of the debt return β in equation (2). Other work in a CAPM framework likewise suggests that β_{Mj} varies over time. In order to deal with this issue, I estimate versions of the two asset pricing equations over different subsamples of the 1979 to 1990 period. This procedure generates statistics that enable me to test for the constancy of the estimated regression coefficients.[5]

The second modeling issue involves possible multicollinearity between the two returns series used as explanatory variables in equation (2). Chance and Lane (1980) argue that returns on debt probably are influenced by the same factors that determine the returns on the market portfolio of stocks. One way to deal with this issue, they suggest, is to orthogonalize one of the series by regressing it on the other. The residual series from this regression, which by definition is uncorrelated with the other explanatory variable, then can be used as a regressor in the equity returns estimating equation. This procedure eliminates the estimation bias and isolates stock market from extramarket effects on stock returns. Of course, the direction of causality in this first-stage regression is not clear. Chance and Lane regress the debt return variable on the stock market return while others, including Lynge and Zumwalt (1980) and Flannery and James (1982), perform the opposite regression.

This second issue may be important for hypothesis testing. Giliberto (1985) shows that the estimated standard errors of the second-stage regression coefficients are unbiased only for the series that was used as the dependent variable in the first-stage regression. This means that studies regressing the stock market index on the debt returns variable, like Flannery and James (1982), may produce biased estimates of the significance of β_{Ij}, but will yield unbiased estimates of the standard errors of β_{Mj}. To determine the empirical significance of this bias, I reestimated all of the equations presented in the next section using both orthogonalizations. While the two series did exhibit significant cross correlation, the orthogonalized results did not differ in a statistically significant way from those reported here.[6] This suggests that any bias resulting from the multicollinearity between the explanatory variables in the two-factor model is not substantial enough to alter the empirical results.

The two asset pricing models described above predict that different firms' equity returns will exhibit differing sensitivities to stock market and debt returns. In terms of the models' parameters, this means that each firm will have its own specific values of α_j, β_{Mj} and β_{Ij}. The estimation results described in the next section are from pooled regressions that combine time-series observations from all the banks in the sample. In Section IV, I group the banks into four size categories and describe regressions on these subsets of banks. The estimated parameter values presented in Tables 2 and 3 are thus averages of the αs and βs for different samples of banks. In this paper, I do not present estimated parameters for individual banks. To reflect this "averaging" in the discussion below, I drop the j subscripts from all α and β parameters (referring to individual banks) when describing the estimation results.

Data

In the current study, I estimate monthly stock returns of a sample of 84 large bank holding companies taken from the Compustat Bank tapes. The monthly returns are derived from end-of-month stock prices, and are adjusted for dividends and stock splits. The Compustat tapes include data on bank holding companies whose stocks trade on a major exchange. This means that the sample includes primarily large banks and is thus not completely representative of all U.S. banks. Of the 84 bank holding companies considered in the current study, the smallest held assets in the first quarter of 1990 of $2.3 billion, while the largest had over $230 billion in assets. The sample was chosen on the basis of availability over the entire interval 1979 to 1990. This period provides a number of observations prior to deregulation of bank interest rates, and also encompasses several cyclical episodes. With 144 time points and 84 banks, the sample includes over 12,000 data observations.

The return on the market portfolio is proxied by the monthly return series on the equal-weighted Standard & Poor's 500 index of stocks. This variable was taken from the Center for Research in Securities Prices (CRSP) tape for the period 1979 to 1988, and from DRI's U.S. Central database for 1989 and 1990. The debt return series is an approximation of the monthly holding period return on 30-year constant maturity U.S. Government bonds. The approximation, as suggested by Flannery and James (1984b), is

$$(3) \qquad -\frac{(Y_t - Y_{t-1})}{Y_{t-1}},$$

where Y_t is the investment yield in month t on the bond. This expression is the percentage change in the bond's yield, multiplied by -1. Note that monthly bond returns fall as yields rise. Thus, a positive estimated coefficient on this variable implies that bank stock returns are negatively affected by increases in bond yields. The yield series used in the construction of this variable was obtained from Citibase.

III. Bank Stock Risk and Return Over Time

A First Look

In describing changes in bank stock risk, it is essential to have an accepted measure of that risk. From the standpoint of portfolio theory, expected or *ex ante* risk is the relevant factor that determines asset prices. Unfortunately, such anticipated risk is generally unobservable. As a proxy, it is common to look at realized, or *ex post*, risk as the appropriate descriptor of asset risk, with the belief that past volatility is a likely indicator of future volatility.[7] Economists typically consider the total variance of historical asset returns (or its square root, the standard deviation) as an appropriate measure of the overall volatility associated with asset returns.

Table 1 contains summary statistics of monthly holding period returns for three different groups of assets for the 1979-1990 period, as well as for four subperiods of that interval. In the first two columns, I present the period averages of the mean and standard deviation of monthly returns for the sample of 84 bank holding company stocks. The second pair of columns contains comparable statistics for the 30 Dow Jones Industrial firms. In both cases, the numbers presented in Table 1 are unweighted averages of the

Table 1

Summary Statistics for Monthly Asset Returns, 1979 to 1990

Interval	84 Bank Stocks (unweighted average)		30 Stocks in Dow Jones Industrials (unweighted average)		30-Year U.S. Treasury Bonds	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Whole-Sample Period						
1979:2-1990:12	0.012	0.083	0.015	0.078	0.001	0.037
Quarter-Sample Subperiods						
1979:2-1981:12	0.015	0.073	0.007	0.070	−0.010	0.045
1982:1-1984:12	0.020	0.078	0.017	0.078	0.005	0.033
1985:1-1987:12	0.012	0.087	0.017	0.091	0.007	0.040
1988:1-1990:12	0.001	0.087	0.019	0.064	0.003	0.025

individual company means and standard deviations during the applicable period.[8] The last two columns in Table 1 contain the mean and standard deviation of the monthly return on 30-year constant maturity Treasury bonds.

The first row of Table 1 contains statistics for the 12-year period, 1979 to 1990. Over this interval, the mean monthly return on both groups of stocks significantly exceeded the mean return on bonds. At the same time, the total risk associated with holding either of these groups of stocks was more than twice the risk of holding Treasury bonds. Between the two samples of stocks, the 30 industrial firms provided a slightly higher mean monthly return and faced somewhat less average risk than the sample of bank holding company stocks, although the differences between the two groups are small. During the full 12-year period, it does not appear that bank stocks were significantly riskier than other equities.

In the bottom portion of Table 1, I divide the full sample period into four subperiods and present the averages of mean monthly returns and standard deviations for the three groups of assets during these different subperiods. The 30 industrial stocks show an upward trend in returns over the four subperiods of the sample, while the bank stocks exhibit a generally downward trend. Notably, in only the 1988-90 subperiod were bank stock returns below the returns on both the 30 industrial stocks and the T-bonds.

While bank stock returns declined in the latter half of the sample period, the variance of these stock returns rose over the course of the 12-year sample period. The average standard deviation of return on the 84 bank holding company stocks was 20 percent higher in the last two subperiods than it was in the first part of the sample. The average risk of the 30 industrial stocks rose through the 1985-87 period, but then declined in the 1988-90 period. The standard deviation of bond returns fluctuated during the four quarters of the sample without any apparent trend. Again, it is notable that, in the last subperiod of the sample, the standard deviation of bank stock returns exceeded the standard deviations of the other two groups of assets. Thus, by the end of the 1979-90 period, bank holding company stocks were more volatile than the other assets and offered investors a lower rate of return.

The numbers presented in Table 1 provide support for the perception that bank stocks have become riskier in recent years. The volatility of bank holding company stock returns increased during the 1980s, both in absolute terms and relative to other portfolios of financial assets, including other equities. At the same time, the average returns to holding bank stocks declined significantly. By the latter half of the 1980s, it appears that investors in bank equities suffered from both higher risk and lower returns.

Risk in the Context of the Two Asset-Pricing Models

The summary statistics of Table 1 confirm that the total variability of bank stock returns increased over the 1979 to 1990 period. However, it is useful to determine if the sensitivity of bank stocks to systematic sources of risk changed during this period. Finance theory predicts that (expected) asset returns should depend on systematic risk and not on total risk. For example, the CAPM suggests that only risk associated with returns on the market portfolio will be compensated by higher expected asset returns. Similarly, the two-factor model predicts that market risk and interest rate risk should be compensated by higher returns. Thus, the higher risks and lower returns on bank stocks observed in the bottom portion of Table 1 could still be consistent with equilibrium asset pricing models if returns fell because systematic risk declined. Estimation of equations (1) and (2) in the previous section can help to shed light on this point.

Table 2 contains regression results from estimating the CAPM and the two-factor model on time series of the monthly stock returns of the 84 bank holding companies in the sample. The coefficients from these estimates correspond to equations (1) and (2) discussed above. The parameter estimates presented in Table 2 are average values across the 84 bank holding companies in the sample. The top part of Table 2 contains estimation results for the full 12-year sample period, while the bottom portion of the table contains estimates from the four subperiods. I test the significance of the estimated coefficients against the null hypotheses that α and β_I are zero and β_M is one.

The CAPM results for the whole sample show that the average covariance of bank holding company stocks relative to the S&P 500 index was less than the "average" stock during the 1979-90 period, as indicated by the estimated β_M of 0.92, which is significantly less than one. This suggests that, over the 12 years of the sample interval, changes in the stock market as a whole were associated with less than one-for-one changes in bank stocks. A long-run value of β_M that is close to one is reasonable because banks are expected to hold diversified portfolios of loans and other assets whose returns should mimic the behavior of the broader market. While this may not be true for small, regional banks, it certainly should apply to the relatively large banks included in the current sample. The positive, significant value of α suggests that, on average, the sample of bank holding company stocks was underpriced during the 12-year period, yielding returns in excess of what would be predicted by the basic CAPM. The model explains only about 25 percent of the total variance of returns during the sample period. This means that bank stock returns contained a large portion of nonsystematic risk.

In the two-factor model for the 12-year sample period, both factors were highly significant in explaining bank stock returns from 1979 to 1990. This confirms previous evidence regarding the sensitivity of bank equity returns to changes in bond yields over and above their sensitivity to the stock market. Moreover, the estimated coefficient, β_I, is positive, indicating that bank stock returns were negatively affected by increases in long-term yields during the sample period. Adding the debt returns variable to the estimating equation reduces somewhat the stock market sensitivity of bank equities. While the change in this coefficient suggests that the two factors may be collinear, the results were the same when the explanatory variables were purged of their common influence. As in the CAPM formulation, the positive and significant value of α suggests that bank stocks were, on average, underpriced during the 12-year period. The expanded model explains about 27 percent of the variance of bank stock returns, only slightly better than the CAPM, and again indicating substantial nonsystematic risk.

Several striking results stand out from the estimates of the two models for the subperiods. First, in the context of

Table 2

Results from One- and Two-Factor Models of Monthly Bank Stock Returns

Model	Interval	α	β_M	β_I	RMSE	$\bar{R}^2$
Whole-Sample Regressions						
CAPM	1979:2-90:12	0.003*** (0.0007)	0.916*** (0.0146)		0.073	0.247
Two-factor	1979:2-90:12	0.005*** (0.0007)	0.828*** (0.0150)	0.373*** (0.0182)	0.071	0.272
Quarter-Sample Regressions						
CAPM	1979:2-81:12	0.007*** (0.0012)	0.719*** (0.0280)		0.067	0.183
Two-factor	1979:2-81:12	0.018*** (0.0013)	0.604*** (0.0266)	0.547*** (0.0259)	0.062	0.291
CAPM	1982:1-84:12	0.011*** (0.0013)	0.929*** (0.0305)		0.070	0.235
Two-factor	1982:1-84:12	0.013*** (0.0013)	0.716*** (0.0354)	0.510*** (0.0452)	0.069	0.266
CAPM	1985:1-87:12	−0.001 (0.0012)	0.928*** (0.0207)		0.068	0.400
Two-factor	1985:1-87:12	−0.001 (0.0012)	0.916*** (0.0205)	0.259*** (0.0311)	0.067	0.413
CAPM	1988:1-90:12	−0.008*** (0.0015)	1.297*** (0.0488)		0.082	0.189
Two-factor	1988:1-90:12	−0.008*** (0.0015)	1.256*** (0.0657)	0.075 (0.0793)	0.082	0.189

Note: *** = significant at 99 percent confidence level
** = significant at 95 percent confidence level
* = significant at 90 percent confidence level
Significance tests are against null hypotheses that the estimated coefficients are zero for α and β_I, and one for β_M.
Standard errors are in parentheses.

the CAPM, market-related systematic risk of bank equity returns, as embodied in β_M, increased during the four subperiods of the 12-year interval. The estimated value of β_M rose from 0.72 in the 1979-81 period to 1.30 during 1988-90.[9] Investors who held bank equities faced more market-related risk over the period and were rewarded for assuming this additional systematic risk by receiving a higher return.

The increase in market-related risk is even more striking when viewed in the context of the two-factor model. Estimated values of β_M more than doubled from the beginning to the end of the sample period, from 0.60 in 1979-81 to 1.26 in 1988-90.[10] These estimates confirm that the systematic, market-related risk of bank holding company stocks increased dramatically during the 1979 to 1990 period.

Perhaps the most striking result in the quarter-sample estimates is the progression of the estimated coefficients on debt returns. The values of β_I decrease monotonically over the four subperiods of the sample, from above 0.50 during both the 1979-81 and 1982-84 periods, to 0.26 from 1985 to 1987, to insignificantly different from zero during the 1988-90 sample period. In contrast to stock market-related risk, the sensitivity of bank equity returns to bond yields declined during the past decade. Moreover, bank holding company stock returns showed no sensitivity to changes in yields in the last three-year period of the sample, the only subinterval for which this was true. While bank stocks faced greater volatility with respect to the stock market, they clearly became increasingly insulated from the effects of bond yield changes.

Of course, systematic bank stock risk is only one aspect of total risk. The remaining portion of risk represents residual, or nonsystematic, bank equity risk. This, too, changed significantly during the 1980s. The two-factor model, for example, explains between 25 and 40 percent of total bank stock returns during the first three subperiods of the 12-year sample interval. By the 1988-90 period, this model explains less than 20 percent of total returns. Thus, the model leaves a large component of bank equity returns unexplained. Clearly, bank stocks entail a substantial amount of asset-specific risk that is not accounted for by the systematic risk factors of these asset pricing models.

Finally, while bank stocks apparently were underpriced on average during the 12-year period, as indicated by the positive values of α in the first two rows of Table 2, market pricing of bank stocks changed during the course of the 1980s. Estimated intercepts were significantly positive during the first two quarters of the sample period, were statistically indistinguishable from zero in the 1985-87 period, and then turned significantly negative in the last part of the sample interval. In terms of the asset pricing models estimated in Table 2, this means that the stocks of the 84 bank holding companies were overpriced in the 1988-90 period, yielding a lower return than the models would predict.

IV. Some Cross-Sectional Comparisons

While the estimates presented in Table 2 contain important information about bank equity risks during the past 12 years, they also conceal substantial cross-sectional variation in bank stocks' responses to stock market and interest rate risk. For example, I estimated values of β_{Mj} and β_{Ij} for each of the 84 bank holding companies during the various subintervals of the sample period. I then generated summary statistics on these "samples" of coefficient estimates. The variance of these coefficients was by far the greatest in the 1988-90 period. That is, there was considerably more variation across bank stocks in their stock market and bond yield sensitivity during the last three years of the 12-year sample period than in any other part of the interval. This suggests that banks may have responded in different ways to changes in their economic and regulatory environment.

One way to separate banks in the sample is by size. It is reasonable to assume that the stocks of different-sized banks may face differing sensitivities to systematic risk factors. For example, the stock of a large bank holding company may reflect its enhanced opportunities for asset diversification. Such a large bank thus may exhibit less variability relative to the broader market than a smaller bank whose opportunities for diversification may be more limited. Similarly, a large bank may be able to exploit possible economies of scale in hedging against interest rate risk that a small bank cannot. These differences will show up in the asset pricing models in terms of different values of β_I. Moreover, if regulators implement, either explicitly or implicitly, a policy of protecting large banks from failure while permitting smaller institutions to go under, such a policy may be reflected in estimates of the asset pricing models and probably will differ across institutions.

To address this question, I split the sample of 84 bank holding companies into four size categories according to dollar amount of assets as of the first quarter of 1987. I then estimated separate regressions for each category.[11] The estimates follow a distinct pattern where size clearly is relevant to the banks' stock sensitivities to the two risk factors. To highlight the differences between the various groups, I present in the four panels of Table 3 the subsample results from the two-factor model for four sizes of banks: assets less than \$5 billion (13 banks), assets between \$5 and \$20 billion (37 banks), assets between \$20 and \$55 billion (24 banks), and assets greater than \$55 billion (10 banks). As in Table 2, significance levels test against a value of β_M equal to one and values of α and β_I equal to zero.

The results in Table 3 suggest that the greatest differences in estimated parameters are between the stocks of the smallest banks in the sample and those of the remaining banks; the three larger categories of banks show quite similar estimation results. For example, the three groups of larger banks all exhibited generally increasing values of β_M over the course of the four subperiods. In contrast, there is no clear trend to the estimated values of β_M for the smallest banks in the sample. Thus, the stocks of the larger banks all became more sensitive to stock market-related risk during the 1980s, while the smaller bank stocks showed no tendency to entail higher market risk. It is notable that the smaller bank stocks had the highest market risk in the first portion of the sample period, 0.8 versus values of β_M between 0.4 and 0.6 for the other three categories of banks. By the end of the sample period, however, the smallest banks had by far the lowest estimated values of β_M, 0.7. The other groups of banks all had estimates of β_M in the last period that exceeded one (although only the largest two groups had parameter estimates that were significantly different from one). Moreover, the stocks of the largest group of banks exhibited the greatest sensitivity to stock market risk of any banks in the sample. The estimated parameter value of 1.8 in the last period of the sample is larger than any other point estimate in this study.

Bank stock sensitivity to bond yields also showed an interesting pattern. Again, the stocks of the smallest group of bank holding companies stand out from the others, while the other three groups of bank stocks look very similar. The stock returns of the three groups of larger banks all exhibited significant sensitivity to bond yields in the first subperiod of the sample, with estimated values of β_I near 0.6. In contrast, the group of smaller bank stocks showed little sensitivity to yield changes, as indicated by the coefficient estimate of 0.2. As the 1980s progressed, the sensitivity of the stock returns for the three categories of larger banks all declined until, in the final three-year period of the sample, none of the banks' equity returns showed any evidence of significant interest rate risk. The stocks of the smallest banks in the sample continued to exhibit little or no interest rate risk in the four subperiods of the sample. While the point estimates remain about the same (0.2), the estimated standard errors increase over time such that the coefficient on the debt return variable is statistically insignificant in the last portion of the sample.

The $\bar{R}^2$ statistics from these regressions indicate that the estimates for each size group leave a large portion of bank stock returns unexplained. Thus, stocks of the different-sized banks in the sample all have a significant component of nonsystematic risk. Moreover, the $\bar{R}^2$ for all four groups declines in the last part of the sample interval, indicating that the proportion of bank stock returns attributable to the two systematic risk factors fell in the 1988-90 period. This is particularly true for the smallest banks in the sample. While the two-factor model explained about 20 percent of stock returns for the other three size groups from 1988 to 1990, it provided less than 10 percent of the explanation for the smallest group of banks. It is not surprising that the stocks of the smaller banks in the sample exhibited the most nonsystematic risk since these smaller banks may be more heavily influenced by bank-specific events and local market conditions. Nevertheless, all banks in the sample, including the largest ones, exhibited significant nonsystematic equity risk.

Finally, the estimated values of α follow the same pattern as for the entire sample, and are roughly similar for all size categories of banks. αs are positive in all four cases early in the 12-year sample period, and all turn negative in the last subperiod. As mentioned above, this means that bank stocks provided abnormally high returns (relative to the predictions of the theoretical asset pricing models) in the late 1970s and early 1980s, and abnormally low returns in the late 1980s.

Table 3

Results From Two-Factor Model by Bank Size
Quarter-Sample Regressions

Panel 1: Banks with Assets less than $5 billion—13 Banks

Interval	α	β_M	β_I	RMSE	$\bar{R}^2$
1979:2-81:12	0.016***	0.809**	0.186**	0.069	0.233
	(0.0035)	(0.0750)	(0.0729)		
1982:1-84:12	0.002	0.601***	0.239*	0.073	0.143
	(0.0034)	(0.0953)	(0.1218)		
1985:1-87:12	−0.009**	0.844**	−0.004	0.083	0.270
	(0.0039)	(0.0641)	(0.0969)		
1988:1-90:12	−0.008*	0.729	0.266	0.084	0.091
	(0.0040)	(0.1722)	(0.2076)		

Panel 2: Banks with Assets between $5 billion and $20 billion—37 Banks

Interval	α	β_M	β_I	RMSE	$\bar{R}^2$
1979:2-81:12	0.017***	0.589***	0.604***	0.060	0.323
	(0.0018)	(0.0385)	(0.0374)		
1982:1-84:12	0.018***	0.571***	0.626***	0.064	0.271
	(0.0017)	(0.0494)	(0.0631)		
1985:1-87:12	0.003	0.886***	0.254***	0.065	0.415
	(0.0018)	(0.0298)	(0.0835)		
1988:1-90:12	−0.006***	1.143	0.150	0.073	0.206
	(0.0021)	(0.0887)	(0.1070)		

Panel 3: Banks with Assets between $20 billion and $55 billion—24 Banks

Interval	α	β_M	β_I	RMSE	$\bar{R}^2$
1979:2-81:12	0.020***	0.606***	0.627***	0.060	0.336
	(0.0023)	(0.0480)	(0.0466)		
1982:1-84:12	0.013***	0.859**	0.452***	0.072	0.288
	(0.0025)	(0.0689)	(0.0880)		
1985:1-87:12	0.002	0.922**	0.347***	0.062	0.464
	(0.0021)	(0.0354)	(0.0536)		
1988:1-90:12	−0.014***	1.490***	0.012	0.086	0.218
	(0.0030)	(0.1294)	(0.1560)		

Panel 4: Banks with Assets greater than $55 billion—10 Banks

Interval	α	β_M	β_I	RMSE	$\bar{R}^2$
1979:2-81:12	0.019***	0.394***	0.616***	0.064	0.236
	(0.0037)	(0.0791)	(0.0769)		
1982:1-84:12	0.010***	1.057	0.571***	0.069	0.399
	(0.0037)	(0.1031)	(0.1318)		
1985:1-87:12	−0.010***	1.104*	0.407***	0.062	0.550
	(0.0033)	(0.0552)	(0.0835)		
1988:1-90:12	−0.001	1.798***	−0.304	0.094	0.217
	(0.0051)	(0.2189)	(0.2639)		

See Notes to Table 2.

V. Conclusion

The results presented above highlight a number of interesting aspects of the behavior of bank holding company stock returns from 1979 to 1990. For example, the total variability of bank equity returns increased during the sample period relative to the returns on industrial equities and on bonds. Moreover, this increased total volatility of returns occurred at the same time that the level of average bank equity returns fell relative to the other assets. By the end of the 1980s, holders of bank stocks faced relatively higher risk and relatively lower returns.

In the context of the asset pricing models estimated in this paper, changes in the total risk and return of bank equities were accompanied by a significant shift in the sensitivity of bank stocks to systematic risk factors. The covariance between bank equity returns and a broad stock market index definitely rose on average during the 1980s. In the latter part of the 1980s, average values of stock market betas for the 84 bank holding companies in the sample exceeded one. Thus, changes in returns on the S&P 500 stock index were associated with a greater than one-for-one movement in bank stock returns, whereas they were less than one-for-one in the early 1980s. This increased stock market sensitivity was especially pronounced for the larger banks in the sample. Thus, the stock returns of large bank holding companies became increasingly sensitive to factors that influence the overall stock market.

One of the most striking findings in this paper is the decline in the bond yield sensitivity of bank stock returns during the estimation period. By the last three-year period in the sample, banks stocks showed no statistically significant evidence of any effects of bond yields on their returns. Moreover, this finding was consistent across banks of all sizes in the sample. The recent lack of bond yield sensitivity contrasts sharply with the behavior of the same bank stocks in the earlier part of the sample period as well as with the findings of previous studies. It is possible to interpret this reduction in interest rate risk as the result of bank managers making greater use of adjustable rate instruments and other hedging strategies to insulate their stock returns from the effects of changes in yields. It is reasonable to conclude that interest rate deregulation and financial market innovations, such as interest rate swaps, financial futures contracts, and adjustable rate mortgages, helped to reduce the interest rate risk of bank stocks by widening the sphere for banks to engage in risk hedging activities.

Of course, there may be alternative explanations for the apparent lack of interest rate risk in bank stock returns in the last part of the 1980s. Shifts in the observed sensitivity of bank equities can reflect changes not only in bank behavior but also in the regulatory environment in which banks operate. For example, in the late 1980s, bank regulators from around the world were negotiating the structure of international risk-based capital standards under the aegis of the Bank of International Settlements. By 1987, the likely future shape of these standards was becoming clear. Under the new standards, risk adjustments to regulated capital levels would be made on the basis of credit risk only and would downplay interest rate risk. While banks might be expected to respond to this change in regulation by increasing their interest rate risk exposure, the change in the enforcement policies of regulators could attenuate the impact of such actions on bank equity values. The net result could be a reduction in the interest rate risk embedded in bank stock returns.

Alternatively, the observed reduction in the debt return sensitivity of bank stocks might be partially explained by a statistical phenomenon. If the variance of debt returns fell significantly from 1988 to 1990 while bank stock returns behaved similarly to earlier subperiods, this might explain the lack of significance for the coefficient on debt returns in the last part of the sample. In fact, the variance of the debt returns series did fall somewhat in the last three years of the sample relative to earlier subperiods. However, this drop in variance probably was not large enough by itself to account for the dramatic decline in the estimated β_I values from 1988 to 1990. More likely it is a combination of factors related to changes in bank behavior, regulatory shifts, and statistical effects that contributed to reduce the measured sensitivity of bank stock returns to changes in bond yields in the last part of the sample period.

Finally, the results presented above support the conclusion that the proportion of nonsystematic risk in bank stocks rose during the 12-year sample period. The asset pricing models explain at most 40 to 50 percent of stock return variability for certain size categories of banks during certain subsamples of the estimation period. The proportion of total variance explained by the systematic risk factors declined for the total and for each size group of banks in the last three-year period of the sample. This means that, in the late 1980s, bank stock risk was more related to bank-specific factors than at any other time since the late 1970s. The increase in nonsystematic risk was greatest for the smaller banks in the sample. An accurate assessment of the stock risk of these banks thus requires less consideration of systematic risk factors and more careful attention to factors specific to the individual institutions.

ENDNOTES

1. The two-index model, though proposed by Stone (1974) in a somewhat *ad hoc* fashion, also can be derived formally from the intertemporal CAPM of Merton (1973), as well as from the Arbitrage Pricing Theory (APT) of Ross (1976). The latter framework suggests that there may be additional factors besides the two considered in these studies that are relevant to explaining asset returns. For example, Chen, Roll and Ross (1986) derive an APT model in which five prespecified macroeconomic factors are used to explain returns on several portfolios of stock. These authors find that several of the factors are important in explaining the returns on diversified stock portfolios. Campbell, Dietrich and Weinstein (1985) test the significance of these five factors on portfolios of financial intermediary stocks. They find that banks stocks are particularly sensitive to measures of default risk and term structure premia (both related to interest rates) as well as to the stock market index. These findings provide some support for the two-index formulation used so extensively in the banking literature.

2. The two holding period return series are expressed in the CAPM in terms of their return in excess of the return on a risk-free security, usually assumed to be a short-term riskless government bond. If no asset is considered risk-free, then it may be possible to construct an asset whose rate of return has zero covariance with the market portfolio. In this "zero-beta" version of the CAPM, the return on this security is considered to be the risk-free rate of return. See Fama (1976) for discussion of this point.

3. If changes in the stock market, and thus the return on the market portfolio, mirror movements in the macroeconomy, then the stock market beta can also be interpreted as measuring the sensitivity of the asset's return to changes in general economic conditions.

4. Again, all holding period returns are expressed in excess of the risk-free rate of return, where that rate is the yield on a short-term Treasury bill.

5. There are, of course, alternative ways to test for time-varying effects on the estimated coefficients. For example, a time trend could be included as an explanatory variable in the regressions, although this would constrain time effects to be linear and monotonic over the estimation interval. Alternatively, it is possible to estimate a shift parameter by interacting dummy variables for different time periods with the explanatory variables in the regression. Beebe (1985) uses this methodology. Another method is to assume that the estimated coefficients depend on some time-varying factor. Embedding this assumption into the regression equations translates into including additional, interacted explanatory variables in the estimates. See Kwan (1991) for an example of this latter approach. The methodology adopted here provides considerable flexibility without imposing additional theoretical or empirical constraints, and generates easily interpreted test statistics.

6. The correlation coefficient between stock market and debt returns was 0.28 during the 12-year sample period and was significantly different from zero.

7. Some modeling approaches permit the use of more direct proxies for *ex ante* risk. For example, Levonian, in an article in this issue of the *Economic Review*, calculates values of *ex ante* risk of bank stocks that are implied by the prices of option contracts on those stocks.

8. I also considered weighting the individual stock returns by the assets of the firms included in the groupings. This weighting did not significantly alter the results presented in Table 1.

9. I conducted Chow tests of the constancy of the set of estimated regression coefficients in the various subintervals of the sample period. For the two halves of the 12-year period, the F-value was 1.24. The critical value for the F-distribution, at a 99 percent confidence level and with (500, 1000) degrees of freedom, is 1.19. My half-sample test had approximately 6000 degrees of freedom in both numerator and denominator. Thus, the set of estimated coefficients in the two half-intervals were significantly different from one another. On the quarter-interval estimates, it was not possible to distinguish the first two quarters of the sample period: the F-value was 1.12, with approximately (3000, 3000) degrees of freedom. The third and fourth quarters of the sample were significantly different from one another: the F-value for this test was 1.46.

10. Chow tests on the constancy of the set of estimated coefficients in the two-factor model confirm that these coefficients changed significantly during the sample. The F-value between the two half-intervals was 1.36; between the first two quarters of the sample, 1.23; and between the last two quarters, 1.48. The critical value of the F-statistic at the 99 percent level, with (500,1000) degrees of freedom, is 1.19.

11. As mentioned in footnote 5, there are alternative ways to estimate cross-sectional differences in risk sensitivity. For example, size measures could be included as additional explanatory variables in the regression equations, or as variables interacted with the two risk factors. The method used here was chosen to highlight differences between banks in the different size categories.

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