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Bank Capital Risk in the Post-1979 Monetary and Deregulatory Environment

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Since the early 1970s, economic risk—as reflected in uncertainty regarding real output, earnings, inflation, and interest rates—has been a major concern to corporate managers, investors, and policy makers. The banking sector has been no exception. In their role as intermediaries, bankers continually have had to monitor and manage risks due to unanticipated changes in inflation and interest rates, defaults, and liquidity. Bank risk has also been of particular importance to insuring agencies and bank regulators.

In structuring their portfolios, bank managers explicitly or implicitly, choose their risk exposure (an *ex ante* choice) with the expectation of earning a return commensurate with the expected risk. Current finance theory suggests that investors in debt and equity markets do not impose a uniquely optimal level of capital risk on individual banks or on the banking system because investors in capital markets can manage the risk of their total wealth by diversifying their portfolios.[1] Regulators also have no way of determining what level of bank risk is optimal. Thus, one cannot make judgmental statements about the level of risk observed.

However, bankers, investors, and regulators have a keen interest in knowing whether bank capital is perceived to have become more or less risky. For example, regulators become concerned when bank risk is increasing because the adverse consequences of bank failures may extend well beyond the losses to bank capital investors. At a minimum, non-insured depositors and insuring agencies bear some of the risk. But because of externalities associated with successive collapses in wealth or possible "runs" by non-insured depositors, the failure of one institution may increase the risk of other institutions. In the extreme, systematic failure can even affect the macroeconomic performance of the economy.

Beginning roughly in late 1979, a number of major developments had the potential of changing the perceived risk of bank capital. During 1979, the inflation rate accelerated sharply, putting upward pressure on market interest rates. By October of that year, the Federal Reserve had changed its monetary operating procedures by placing greater emphasis on controlling the quantity of money while allowing the federal funds rate to fluctuate over a wider range in the short run. Coinciding with the new operating procedure was a substantial increase in the volatility of market interest rates. Upward pressure on the level of interest rates also mounted with the prospect of chronic federal government deficits and monetary restraint.

In the latter half of 1979, momentum was building in Washington for landmark legislation to deregulate banks. By March 1980, Congress had passed the Depository Institutions Deregulation and Monetary Control Act, which, among other things, called for the removal of deposit-rate ceilings at banks and thrifts by 1986 and extended deposit insurance from $40,000 to $100,000 per account. From March through July of 1980, the Federal Reserve also imposed the Credit Control Program, which was directed largely at constraining the growth of bank credit. These developments taken together set the stage for what could have been perceived as a significant change in bank risk.

The purpose of this paper is to compare actual market measures of bank capital (debt and equity) risk in the pre- and post-October 1979 periods.[2] The paper examines whether or not there was a significant change in measured bank capital risk in the post-late-1979 era of monetary and fiscal policy uncertainty, interest-rate volatility and pending

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deposit-rate volatility. But because of the many factors affecting the market's perception of bank capital risk, neither the individual influences nor the extent to which a change in risk might have been due to government protection or increased deposit insurance can be determined.[3]

In summarizing the evidence comparing risk in the pre- and post-late-1979 periods, the picture is encouraging. For the latter period as a whole, there is no evidence of a significant rise in capital risk of banks with over $1 billion in assets. Measures of total capital risk changed little between periods, while the sensitivity of bank equity to overall stock-market risk actually declined between the two periods for most banks. (The decline was statistically significant for the group of largest banks—over $10 billion in assets.) On the whole, the largest banks reduced the risk exposures of their equities (elasticity of returns with respect to general stock price movements) far more than did the banks in the smaller groups ($1-5 billion and $5-10 billion).[4]

This paper is divided into three sections. In Section I, the theoretical underpinnings of the various measures of bank risk and the possible effects of the post-1979 economic and regulatory environment on bank risk are discussed. In Section II, the empirical evidence is presented. In Section III, conclusions are drawn.

I. Hypotheses of Bank Risk

In observing the capital risk of banks, it is important to distinguish between the *sensitivity* of bank capital risk to overall capital risk in the stock and bond markets (primarily a concept of *ex ante* risk posturing) and the actual level of bank capital risk observed (an *ex post* measure). For example, economic risk, as it impacts on earnings and interest rates, will affect capital values in the overall stock and bond markets. One question to be addressed is whether banks have positioned their portfolios, operations, and capital leverages to make their capital relatively sensitive or insensitive to such economic risks.

The single-index market model from the finance literature postulates that capital risk *sensitivity* can be represented by the equity "beta," or the measured sensitivity of the firm's (or portfolio's) equity return with respect to the return on the market bundle of risky assets, usually proxied by the return on a broad stock market index (originally, Sharpe, 1963). Precisely because it is measured in relation to a broad index of risky assets, beta represents sensitivity to commonly experienced, or non-diversifiable risk, and assets with a high beta should earn a return premium in the capital markets (originally, Sharpe, 1964).

The single-index model has since been extended to various multi-index models. One extension uses a two-index model in which the two indices are returns on a broad index of common stocks (e.g., the S&P 500) and returns on an index of default-free debt instruments (e.g., Treasury issues). The first index represents "non-diversifiable risk," which includes the risk associated with all factors that affect the stock market, such as expected earnings, interest rates, inflation, defaults, and so forth. (Since interest rates comprise one factor affecting the stock market, the two indices obviously are not independent.)

Bank equity is sensitive to all of the factors that affect the stock market, including interest rates. For example, banks are sensitive to "earnings risk" through possible defaults on their loans and investments, changes in loan demand, and potential variability in growth and profitability of their own (non-portfolio) operations. Bank portfolio returns also are subject to (nominal) interest rate risk because banks carry assets and liabilities that are usually contracted in nominal dollars and which normally differ in duration.[5] Bank equity values are sensitive also to interest rate risk because the real interest rate affects the discounting of future earnings. The question to be addressed is whether banks are positioned in such a way that their capital is relatively exposed to or insulated from the economy-wide sources of risk that are reflected in overall stock and bond market volatilities.

In this paper, risk *sensitivity* is measured in several ways: (1) by estimating the bank stock beta, which measures sensitivity to all commonly experienced non-diversifiable risk factors as they affect the S&P 500; (2) by estimating the sensitivity of bank stock returns to returns on 1-year Treasury bills (i.e., interest rate risk); and (3) by measuring whether bank stocks are responsive to Treasury bill returns beyond the sensitivity to interest rates already reflected in movements of the overall stock market (S&P 500).

While a bank may attempt to posture its risk sensitivity through discretionary *a priori* portfolio and operational policies, the risk inherent in the economic environment will determine how these policies translate into *ex post* measures of actual capital risk. For example, a bank could attempt to insulate itself *ex ante* from risk, but if total risk in the market were to rise, the bank's *ex post* capital risk actually could increase. Thus, the analysis examines not only the *elasticities* (sensitivities) of the prices of bank equities with respect to stock and T-bill prices, but also direct measures of bank-debt risk premia, bank equity returns, and the dispersion of those returns. These measures represent actual *ex post* bank risk as opposed to *ex ante* risk posturing.

Several forces in the post-1979 environment might have affected the capital risk of banks: (1) During 1979 and early 1980, there was a rapid acceleration in the rate of inflation and in the level of interest rates while the economy was operating roughly at capacity. Such developments in the past often have been followed by recessions. (2) In October 1979 the Federal Reserve changed its short-term operating procedure for monetary policy. (3) Beginning in late 1979, legislation (of unknown specifics at the time) to deregulate banks was becoming increasingly imminent, and resulted in the Depository Institutions Deregulation and Monetary Control Act of March 1980. (4) Credit controls were imposed during the March-July period in 1980, and their possible re-imposition must have presented some continued threat to the efficient operation of financial institutions. (5) Finally, the monetary-fiscal policy dilemma caused by tax changes and the prospect of chronic federal deficits began to surface in 1980 and 1981.

It is very difficult to say *a priori* how these events should have affected bank risk. For example, one cannot say unequivocally whether the Federal Reserve's change in operating policy should have diminished or increased either interest rate or real earnings risk. From a monetarist point of view, the *short run* variability of the federal funds rate and perhaps even other interest rates, economic activity, and real earnings might have increased, while the risk of major fluctuations would have abated. From a Keynesian point of view, variability of most interest rates, and perhaps real earnings, might have increased even in the longer run.

It is difficult to predict how deregulating consumer deposit ceilings also might have affected bank risk.[6] Ignoring the effect of deposit insurance for the moment, it is likely that removing consumer deposit ceilings might actually reduce bank risk in the long run because the shift from non-interest to interest payments on deposits presumably would enable a bank to shift from quasi-fixed factors of production—buildings and other convenience or nonprice concessions—to highly flexible factors—interest payments (Mingo, 1978 and Quick 1977).

While the deregulation of consumer deposit ceilings might have some effect in reducing bank risk by affording banks a more efficient and flexible means of attracting deposits, it might also increase the desired risk exposure of banks by increasing the likelihood that marginal liabilities would fall under the umbrella of deposit insurance. As a consequence of consumer deposit-rate deregulation, banks are freer to bid up the rates on *insured* deposits of up to $100,000 denomination. If marginal bank liabilities shift from non-insured to insured sources, the discipline imposed by lenders (i.e., depositors) is lessened. The deregulation of (insured) consumer deposits might then tend to increase the optimal *ex ante* risk exposure of a bank.

In part because there is no necessarily optimal level of risk for bank capital and in part because the several factors in the post-1979 environment might have either increased or decreased bank risk to varying degrees, any change in observed bank risk is simply an empirical question. The author's *a priori* expectation was that large banks probably attempted to reduce the *ex ante* exposures (sensitivities) of their capital to interest-rate and economic risk after the mid-1970s (Beebe, 1977).[7] The actual *ex post* risk to be observed in the post-1979 period was an open question.

II. Evidence of Risk

Month-end closing prices of common equity were obtained from Data Resources, Inc. (DRI) for 91 large bank holding companies and banks (henceforth referred to as "banks") ranging in total assets (year-end 1981) from $1 billion to $121 billion. The choice of institutions was based on the availability of stock data that indicated frequent trading[8]: 52 banks had assets of $1-5 billion, 19 had assets of $5-10 billion, and 20 had assets of $10-121 billion.

Secondary-market month-end quoted yields were obtained for 15 debt issues of 15 different bank holding companies and banks.[9] The institutions associated with the 15 issues ranged in size from $1.7 billion to $121 billion, with 8 in the $1-5 billion group, 2 in the $5-10 billion group, and 5 in the $10+ billion group.

In the following analysis, evidence on bank debt and equity *ex post* capital risk is presented first (Charts 1 and 2 on debt and Tables 1 and 2 on equity). Then the more complex regression analysis of *ex ante* risk posturing follows (Tables 3-5).

Debt Risk

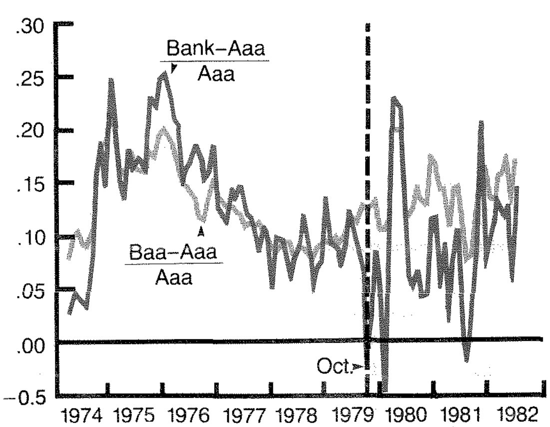
Chart 1 shows the risk premia for Moody's Baa bonds and for an equally weighted index of the fifteen bank debt issues, both relative to Aaa corporate issues.[10] Throughout most of the 1974-79 period, the bank bonds on average were considered by the market to be about as risky as Baa bonds. However, during the post-1979 period, the bank bonds were considered to be less risky than Baa's. In fact, the post-1979 period shows very little increase in the average risk premium for these 15 bank debt issues, with the exception of the Credit Control period (March-July, 1980) and possibly a small increase in 1982.

Chart 2 reports the *cross-sectional* coefficient of variation of yields within the 15-bank-bond index. (The coefficient of variation is the standard deviation divided by the mean. It measures the extent to which the risk premia differ across the fifteen banks.) Interestingly, the cross-section dispersion of yields increased markedly immediately after October 1979 and through the Credit Control period when the cross-sectional dispersion reached its high 1975 level. After the Credit Control period, however, the dispersion of bank yields (risk premia) has remained well below that of the turbulent 1974-1976 period.

Charts 1 and 2 taken together indicate that, since 1979, bank-debt risk premia (for these 15 large banks) have neither risen significantly on average nor become more dispersed across the banks, except during the period of Credit Controls. One may conclude, then, that these bank debt issues have not been viewed as becoming more risky in the post-1979 period.

Chart 1

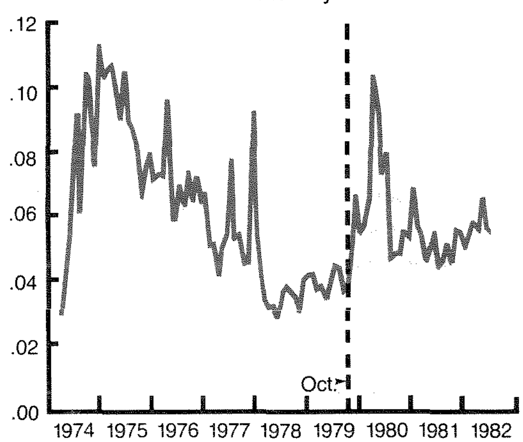
Bank/Aaa and Baa/Aaa Debt Risk Premia



Aaa and Baa yields are end-of-month. Bank bond index is an equally weighted end-of-month yield of fifteen major bank debt issues.

Chart 2

Dispersion of Bank Debt Yields About Their Monthly Means



Monthly cross-section coefficient of variation (standard deviation divided by mean) of month-end yields for fifteen major bank debt issues.

Equity Returns

Table 1 shows equity returns (excluding dividends) for the pre- and post-1979 periods.[11] In the 1972-79 period, bank equity returns were very close to those on the S&P 500, although the large-bank group performed moderately better than the small-bank group.[12] In the post-1979 period, the group of $1-5 billion banks performed considerably better than the S&P 500, and the two groups of larger banks, considerably poorer. But within the post-1979 period, there was a distinct break in stock price behavior, with a persistent decline in the stock market beginning in December 1981 and continuing throughout the sample period. The two groups of large banks registered a decline in stock prices that was much more severe than that of the S&P 500, an indication that the market might have reassessed the expected earnings of the largest banks beginning in late 1981.

Equity Risk

The standard deviation of equity returns over a period of time is commonly used as a measure of equity (total) risk. Table 2 presents standard deviations of monthly equity returns (excluding dividends) for the bank groups for the pre- and post-1979 periods. Between the two periods, the standard deviation of equity returns declined for all three groups of banks. The decline was greatest for the group of largest banks; for this group, the standard deviation declined even in comparison to that of the S&P 500.[13] The table indicates that the total equity risk of the largest banks declined both absolutely and relatively in the post-1979 period. As indicated by the regression results reported below, this lower risk can be interpreted in part as the consequence of discretionary policies taken by the largest banks either prior to or during the post-1979 period.

Table 1
Bank Equity Returns

(Monthly Percentage Returns at Annual Rates, Excluding Dividends[1])

		1979:10–1982:07		
	1972:08–1979:09	**Full Period**	**1979:10–1981:11**	**1981:12–1982:07**
All Banks	−0.5%	2.1%	12.0%	−27.5%
$1-5 billion	−1.5	6.2	14.5	−16.7
$5-10 billion	0.3	−3.4	6.1	−29.0
$10+ billion	1.1	−3.5	10.9	−38.7
S&P 500	0.3	0.7	6.9	−22.0

[1] Monthly percentage returns are calculated for each bank over the period. Equally-weighted cross-section average returns are calculated for each group of banks. Geometric mean returns for the group indices are then calculated for the sample periods.

Table 2
Bank Equity Risk

(Standard Deviations of Monthly Percentage Returns at Monthly Rates[1])

	1972:08–1979:09		1979:10–1982:07	
	Standard Deviation	Relative to S&P 500[2]	Standard Deviation	Relative to S&P 500[2]
All Banks	8.05%	1.71	7.82%	1.75
$1-5 billion	7.91	1.68	7.81	1.75
$5-10 billion	8.37	1.78	8.23%	1.85
$10+ billion	8.11	1.72	7.46	1.67

[1] Standard deviations of monthly percentage returns (at monthly rates) are calculated for each bank over the period. Period averages are then calculated using equal weights for each bank in the group. Returns exclude dividends.

[2] The standard deviation of bank returns divided by the standard deviation of returns on the S&P 500 (excluding dividends).

Risk Posturing

The above measures of *ex post* debt and equity risk are the combined consequence of risk posturing by banks and total risk in the stock and bond markets. The risk sensitivity measures reported below, although measured on an *ex post* basis, are interpreted as exposures to total risk, and hence the result of *ex ante* risk posturing. (As noted later, one could argue also that they are the consequences of implied regulatory protection.)

As described earlier, the single-index stock market model employs the equity beta as a measure of non-diversifiable, or market-related, risk. Specifically, beta is a measure of the elasticity of equity prices with respect to the price of the market basket of risky assets, normally proxied by the stock market (here by the S&P 500, exclusive of dividends).[14] Because it is a measure of sensitivity to non-diversifiable risk factors, the magnitude of beta can be interpreted as being the consequence of *ex ante* discretionary policies employed to manage capital risk.

For the individual bank, the single-index stock market model for the full sample period with a shift in beta at 1979:10 is as follows:

$$BK_t = \alpha + \beta SP_t + \beta_s(SP_t \times D) + e_t \qquad (1)$$

where

BK_t = monthly stock price percentage return (excluding dividends) for the individual bank (closing prices for the last trading day of the month)

SP_t = monthly percentage return (excluding dividends) on the S&P 500 (closing prices for the last trading day of the month)

α = "excess return," excluding dividends for the period in question—i.e., in excess of the return earned for taking on non-diversifiable risk, as measured through beta

β = the elasticity of bank-stock prices with respect to the S&P 500

β_s = shift in β at 1979:10

D = 0, 1 dummy to estimate the shift in β (D = 1 for the second subperiod)[15]

e_t = standard error, interpreted as nonmarket-related, or residual, risk

Equation (1) was estimated separately for each of the 91 banks.[16] The individual bank results were then summarized in Table 3 by reporting the *median* values of the parameter estimates, t-statistics and regression statistics for (1) all 91 banks, (2) the 52 banks in the $1-5 billion size class, (3) the 19 banks in the $5-10 billion size class, and (4) the 20 banks in the $10+ billion size class. In addition, the *percentages* of significant t-statistics are reported along with *median*- t-values.

Table 3
Bank Equity Risk Related to the S&P 500

(Median Values of Individual-Bank Regressions—
1972:08–1982:07, with Dummy Shifts at 1979:10)

	α^1	β_0^2	β_1^2	β shift[3]	R^2	D.W.	σ^1
All Banks	.09	.90	.76	−.13	.28	2.15	6.48
	(.16;3%)	(6.11;100%)	(2.94;91%)	(−.45;20%)			
$1-5 billion	.10	.84	.79	−.03	.24	2.17	6.67
	(.17;4%)	(5.46;100%)	(2.91;92%)	(−.11; 8%)			
$5-10 billion	.09	.97	.84	−.13	.32	2.14	6.80
	(.16;5%)	(6.64;100%)	(3.28;95%)	(−.48;16%)			
$10+ billion	.04	1.16	.63	−.48	.36	2.16	6.26
	(.07;0%)	(8.05;100%)	(2.54;85%)	(−1.74;55%)			

Subscripts refer to pre- and post-1979:10. Figures in parentheses are median t-statistics (against the null hypotheses that the coefficients are zero) and percentages of individual t-statistics that exceed the 5-percent critical level using a one-tailed test (two-tailed for α)—t-critical = 1.66 for one-tailed tests.

[1]Units are monthly percentage changes, nonannualized.
[2]Elasticity of bank-stock price with respect to the price of the S&P 500.
[3]Because the values reported are group medians, the reported shift coefficients do not necessarily equal the differences between the period coefficients.

The results for beta are quite striking. Beta was higher for the largest banks than for the other banks in the first subperiod. By the second period, beta was actually lower for the largest banks than for the smaller banks, and for the largest banks its decline between subperiods was statistically significant. (For the shift coefficient, the median t-value was −1.74 compared with a critical value of −1.66, and 55% of the individual t-values were significant.) This evidence is consistent with the hypothesis that the largest banks (over $10 billion in assets) postured their portfolios to insulate their capital from non-diversifiable, or market-related, risk.[17]

The estimate of beta conveys the sensitivity of bank-stock prices to real economic activity, interest rates and all other "common factors" that impinge on equity prices. The fact that such factors are numerous, complex, and correlated—and that we do not have a reliable structural model to sort them out—means that we cannot identify the individual factors that explain beta. However, we can examine the sensitivity of bank equity capital to interest-rate risk. Tables 4 and 5 present these results.

The regression for sensitivity to interest rate risk is:

$$BK_t = \alpha + \gamma TB_t + \gamma_s (TB_t \times D) + e_t \quad (2)$$

where

BK_t = monthly stock price percentage return for the individual banks (closing prices for the last trading day of the month)

TB_t = monthly percentage return on 1-year Treasury bills for the holding period from the first to the second month of the life of the T-bill (calculated from closing yields on the last trading day of the month)[18]

α = average elasticity-adjusted return differential, excluding bank dividends, between T-bills and bank stocks

γ = elasticity of bank-equity prices with respect to the price of 1-year Treasury bills

γ_s = shift in γ at 1979:10

D = 0, 1 dummy to estimate the shift in γ (D=1 for the second subperiod)

e_t = standard error of the regression

Table 4
Bank Equity Risk Related 1-Year Treasury Bills

(Median Values of Individual-Bank Regressions—
1972:08–1982:07, with Dummy Shifts at 1979:10)

	α[1]	γ_0[2]	γ_1[2]	γ shift[3]	R^2	D.W.	σ[1]
All Banks	−1.64	2.95	1.99	− .88	.05	2.03	7.74
	(−1.62;44%)	(1.84;58%)	(2.40;88%)	(−.60;12%)			
$1-5 billion	−1.38	2.18	1.95	− .37	.04	2.04	7.78
	(−1.36;29%)	(1.36;42%)	(2.39;87%)	(−.25; 0%)			
$5-10 billion	−1.91	3.95	2.06	−1.58	.06	1.98	7.86
	(−1.70;58%)	(2.18;74%)	(2.63;89%)	(−1.17;32%)			
$10+ billion	−1.93	3.61	1.92	−1.86	.05	2.10	7.63
	(−1.97;70%)	(2.42;85%)	(2.28;90%)	(−1.18;25%)			
S&P 500[4]	−1.11	2.55	0.85	−1.70	.05	1.99	4.51
	(−1.89)	(2.70)	(1.72)	(−1.82)			

Subscripts refer to pre- and post-1979:10. Figures in parentheses are median t-statistics (against the null hypotheses that the coefficients are zero) and percentages of individual t-statistics that exceed the 5-percent critical level using a one-tailed test (two-tailed for α)—t-critical = 1.66 for one-tailed tests.

[1] Units are monthly percentage changes, nonannualized.
[2] Elasticity of bank-stock prices with respect to the price of the S&P 500.
[3] Because the values reported are group medians, the reported shift coefficients do not necessarily equal the differences between the period coefficients.
[4] Estimates reported are for a single regression on the index for the S&P 500, and thus are not median values.

Equation (2) postulates that bank stock prices are affected by T-bill prices (i.e., the inverse of interest rates) with a possible change in the elasticity at October 1979. In equation (2), BK and TB are monthly holding-period *returns* on bank stocks and 1-year Treasury bills, respectively. For debt instruments, holding-period returns are inversely correlated with interest rates (yields). Since stock prices generally are inversely correlated with interest rates (yields), we should expect stock prices to be *positively* correlated with returns on debt instruments (i.e., the sign on γ is expected to be *positive*.) Treasury bills are used as the representative debt instrument because they are default-free and are pure discount instruments (that is, they bear no coupons), and hence, have a constant duration regardless of the level of interest rates.[19]

In Table 4, results from equation (2) are presented for the 91 individual banks and for the S&P 500. These results show that interest rates have a significant effect on the equity prices of banks and the S&P 500 in both periods. For the bank stocks, interest rate sensitivities do not increase in the post-1979 period, and tend to decrease for some of the banks in the two larger size groups. (The R^2 is surprisingly small for all regressions, however, indicating that interest rates explain only a small portion of stock-price variance.)

Interest rates ought to affect bank stock returns in at least two ways. First, if banks make contracts whose payment streams are fixed in nominal dollars (e.g., fixed-rate mortgages), then unexpected changes in *nominal* rates should affect the market value of the bank's portfolio depending upon the extent to which interest rate risk is more or less hedged. Second, unexpected changes in the *real* interest rate should affect the present value of expected dividends attributable to taking on risk, generating information needed for lending, and providing operational services. The latter effect is similar to that impacting on all equities, not just bank stocks, and the extent to which only the real rate affects equities depends on the extent to which real corporate earnings are hedged against inflation.

In the bottom line of Table 4, it is apparent that S&P 500 returns are sensitive to interest rates. The sensitivities are significant in both periods, and there is a significant downward shift in the relationship.[20] The large downward shift in interest-rate risk sensitivity for the S&P 500 between the two subperiods is perplexing. Since equity valuation ought to be sensitive generally to changes in the *real* interest rate, two possible explanations come to mind. Either there was a structural shift in the way the market evaluated the effect of *real* interest rate changes on the present value of equities after 1979, or the market attributed a larger proportion of *nominal* interest rate volatility after 1979 to changes in the inflation premium. Although some research has concluded that variability of inflation premia has caused much of the variability in debt yields since October 1979, other research disagrees. The downward shift in the S&P 500's sensitivity to interest rates requires further study.[21]

In light of the results for the S&P 500 in Table 4, it is possible that much of the response of bank stocks to interest rates is felt through a change in the discount rate applied to the expected dividend stream rather than through any specific effect of interest rates on banks' portfolios. To test this hypothesis, the right-hand variables for returns on the S&P 500 and 1-year T-bills were entered simultaneously within a single regression:

$$\begin{aligned} BK_t = {} & \alpha + \beta SP_t + \beta_s(SP_t \times D) \\ & + \gamma TB_t + \gamma_s(TB_t \times D) + e_t \end{aligned} \qquad (3)$$

where the variables are defined as before.

Equation (3) postulates a two-factor market model in which bank stock prices are related not only to "common factors" as reflected in the S&P 500 but also to an additional "interest rate" factor beyond that already reflected in the S&P 500. Although multi-index models often are estimated by first orthogonalizing the right-hand variables relative to one another, this method causes an unjustifiable upward bias in the t-statistics and, therefore, the method of ordinary least squares is used in this paper.[22] (As suggested by the low R^2 of .05 in the bottom row of Table 4, multi-collinearity between SP and TB should not present an estimation problem).

The results reported in Table 5 help to confirm the implication that arises from comparing the bank stock results of Table 4 with the S&P 500 results: that the interest rate effect on bank stock prices is not very different from the general effect of interest rates on common stocks. Although γ in Table 5 is positive in both periods, it is significant only in the second period. Moreover, its magnitude is reduced from the estimates in Table 4, and it adds little explanatory power over the regressions on beta alone in Table 3.[23] The perplexing behavior of interest rates in the latter period generally makes it difficult to speculate on the economic reasoning behind the results in Table 5.

Table 5
Bank Equity Risk Related to the S&P 500 and 1-Year Treasury Bills

(Median Values of Individual-Bank Regressions—
1972:08–1982:07, with Dummy Shifts at 1979:10)

	α^1	β_0^2	β_1^2	β_{shift}^3	γ_0^4	γ_1^4	γ_{shift}^3	R^2	D.W.	σ^1
All Banks	−.60	.90	.64	−.21	.65	1.39	.65	.29	2.19	6.50
	(−.69;12%)	(5.93;100%)	(2.55;82%)	(−.67;25%)	(.53; 9%)	(1.94;66%)	(.50; 9%)			
$1-5 billion	−.42	.82	.65	−.13	.31	1.38	1.13	.25	2.19	6.63
	(−.46;10%)	(5.31;100%)	(2.46;83%)	(−.48;15%)	(.22; 2%)	(1.91;69%)	(.88;12%)			
$5-10 billion	−.82	.88	.80	−.21	1.42	1.43	.10	.34	2.17	6.58
	(−.77;21%)	(6.05;100%)	(2.79;89%)	(−.85;16%)	(.85;21%)	(2.01;68%)	(.06; 5%)			
$10+ billion	−.93	1.13	.54	−.58	1.23	1.29	−.05	.39	2.15	6.21
	(−1.03;10%)	(7.62;100%)	(2.23;75%)	(−2.02;60%)	(.95;15%)	(1.84;55%)	(−.03; 5%)			

Subscripts refer to pre- and post-1979:10. Figures in parentheses are median t-statistics and percentages of individual t-statistics that exceed the 5-percent critical level. (One-tailed tests for negative shift for β and positive shift of γ; two-tailed test for α)—t-critical = 1.66 for one-tailed tests.

[1] Units are monthly percentage changes, nonannualized.
[2] Elasticity of bank-stock prices with respect to the price of the S&P 500.
[3] Because the values reported are group medians, the reported shift coefficients do not necessarily equal the differences between the period coefficients.
[4] Elasticity of equity prices with repect to the price of 1-year Treasury bills.

III. Summary and Conclusions

The evidence presented here indicates that the post-1979 economic and regulatory environment did not significantly increase the capital risk of banks (and bank holding companies) with over $1 billion in assets. With the exception of the Credit Control period (March-July 1980), the risk premium on debt capital of the fifteen institutions rose very little above its low level of 1977-79 and remained well below the high debt-risk premium period of 1975-76. Moreover, the standard deviations of equity returns for the 91 institutions with assets of $1-121 billion were lower on average in the post-late-1979 period than in the 1972-1979 comparative period. For the largest institutions ($10+ billion), the standard deviation of equity returns even declined in comparison to that of the S&P 500.

The sensitivity of bank equity to common risk factors, as measured by the equity beta, also declined in the post-1979 period compared to the earlier period, and the decline was statistically significant for over half of the twenty banks in the $10+ billion size group. For the twenty largest banks, the median beta declined from 1.16 to 0.63. This evidence suggests that investors perceived the capital of these banks to be more insulated from common risk factors (economy-wide interest-rate, earnings, and bankruptcy risk) in the post-1979 period than in the earlier period.

Although bank equities are sensitive to interest rates, the sensitivity did not increase in the post-1979 period, and declined significantly for some of the banks in the two larger size groups. However, the general stock market sensitivity to interest rates declined significantly, and by a comparatively greater amount. After taking account of the change in general sensitivity of the stock market to interest rate volatility, as reflected in beta, the specific sensitivity of bank stocks to interest rates was reduced considerably, and was statistically significant only in the post-1979 period. Given the perplexing behavior of interest rates in the latter period, it is difficult to draw firm conclusions regarding changes in the effect of interest rates on bank stock prices.

The post-late-1979 period is regarded generally as having been a turbulent period for inflation, economic activity, interest rates, and banking deregulation. The evidence of stable capital risk for banks of over $1 billion in assets (and declining betas for the $10+ billion banks) is encouraging, although not necessarily surprising in view of the fact that banks with assets over $1 billion are regarded generally as being relatively well-insulated from interest rate risk and the adverse consequences of deregulation.

The result could be attributed to investor perceptions that regulators (particularly the insuring agency) and legislators increasingly protected the capital holders of large banks, or to discretionary policies by the managements of these banks to reduce the risk of their capital by altering their portfolios, operations, and capital leverages. Although one cannot determine from the data whether the relative stability of bank capital risk is due to perceived regulatory protection or discretionary policies by bankers, the author is inclined to suspect the latter (Beebe, 1977).

FOOTNOTES

1. Because investors in capital markets can manage the risk of their total wealth by diversifying their portfolios, the capital markets do not dictate a unique set of preferences, and hence an optimal level of risk, *vis-a-vis* any single investment or group of investments such as bank debt or equity.

2. The data end in July 1982 simply because they were assembled in the Fall of that year. Passage of the Garn-St Germain Act would not have affected the data, as its passage was not anticipated prior to about September 1982.

3. For example, it is possible that investors simply perceived banks as being more protected by government policies in the turbulent post-1979 period and hence bank capital values became less volatile than they otherwise would have been.

4. The evidence turned up what appears to have been an increase in bank capital risk beginning in 1982. This development is not examined in the paper because the sample period ends in July 1982. It is the subject of a subsequent study by the author.

5. See especially Flannery (1981 and 1982) and Flannery and James (1982 and 1983) on interest rate risk of banks. The impetus of much of this paper comes from their work.

6. There is a longstanding, albeit unpersuasive, argument that the removal of deposit ceilings would have caused bankers to preserve earnings spreads by investing in riskier assets. Benston (1964) calls this postulated effect the "profit-target" hypothesis, as opposed to the "profit-maximum," hypothesis. See Mingo (1978) for a discussion.

It is unlikely that the profit target hypothesis had merit even at a time when most or all of banks' liabilities were subject to ceiling rates. Even if deposit ceilings were binding on all bank liabilities, profit-maximizing banks would raise additional funds by bidding up the marginal cost of funds to market-equivalent yields through non-interest concessions. Deposit ceilings would lower the marginal cost of funds for profit-maximizing banks only if the ceilings somehow also lowered the yield on all the non-bank alternatives available to depositors (both personal and commercial)—an unlikely prospect.

Particularly in recent years, however, deposit ceilings have pertained only to some bank liabilities, and banks clearly have paid explicit interest at market rates in the unregulated commercial deposit and non-deposit markets for their marginal funds. It is difficult, therefore, to argue that removing deposit ceilings would lead banks into riskier assets, as removing the ceilings would change only the average cost of funds, not the marginal cost.

7. In an earlier paper, the author examined the aggregate bank portfolio over the post-WWII period in an effort to explain how banks had employed active liability management to affect their growth and risk postures (Beebe, 1977). A clear picture emerged that both growth and non-diversifiable risk exposure of large banks accelerated during the 1960s and early 1970s. (The average equity beta of large banks rose from 0.5 to 1.1 between the late 1950s and early 1970s.) The author postulated that in response to the riskier economic environment of the mid-1970s, large banks might reduce their risk exposure. This result is borne out in the present study, as the beta for banks over $10 billion in assets declined from 1.2 to 0.6

8. The author thanks Chris James of the University of Oregon for providing the names of DRI banks with well-behaved stock price series. The list of banks in this study differs from the samples in the various studies done by Mark Flannery and Chris James. They restricted their sample to holding companies with identifiable lead banks. The present study consists of holding companies and banks

that are listed by Compustat and that have monthly stock price data dating back to 1972 in the DRI database.

9. Month-end quoted yields were obtained from Moody's Bond Record, and information on the bonds, from Moody's Bank and Finance Manual. Reliable data were available for only 15 bank holding companies and banks. The bonds were issued between February 1971 and March 1974. All had call options after 10 years at par or slightly above, and all carried coupons such that they initially sold approximately at par. Eleven had initial maturities of 25 years and four had maturities of 30 years.

There is a dearth of regularly traded bank debt issues in the secondary market. Even for these 15 issues, which Moody's considered to be frequently traded, statistical analysis of the monthly returns indicated that the bonds were not always traded at month-end. Serially correlated errors in the returns with respect to the returns on broad bond indices implied average lags of over a week, a sign of infrequent trading and/or data that are based on bids rather than actual trades. For this reason, bank bond risk premia are reported only in graphical form.

10. In Charts 1 and 2, risk premia were divided by the level of interest rates because the change in yield (or yield differential) is directly proportional to the level of yields for any given holding period percentage return.

The increased variance after October 1979 in the Bank/Aaa differential in Chart 1 may be due to short-run discrepancies caused by infrequent trading of bank bonds during the period of great day-to-day volatility in bond prices. Aaa and Baa rates are for the last trading day of the month. Although reported bank bond rates are also quoted for the last trading day of the month, statistical tests indicated infrequent trading throughout the entire sample period, in that yields lagged behind those of the broad indices (See footnote 9).

11. Bank equity data are common stock prices as of closing on the last trading day of the month. Monthly percentage returns are calculated as percentage changes in price. Returns exclude dividends because dividend data were not available. Lack of dividend data seriously affects calculations of *average* returns (as in Table 1) but has little effect on the measures of the *variability* of returns used in the regressions and reported in Tables 2-5.

12. Differences in dividend policies are unknown to the author. Dividend differentials could have a substantial effect relative to such a small discrepancy.

13. Because the S&P 500 is a portfolio of diversified stocks, its standard deviation understandably is below the average standard deviations of its component issues and of the individual bank issues. While the absolute level of the bank standard deviations relative to that of the S&P 500 conveys no meaning, changes over time are meaningful.

14. Given the wide variations of price returns using monthly data, omitting dividends affects estimated betas only slightly. Returns are sometimes expressed in excess of the risk-free rate of return, a nuance that also has little effect on empirical results. Ideally, in place of the S&P 500, one would use returns of a value-weighted index of all risky assets, including debt and real estate. Such an index does not exist.

15. The t-statistics for β in the second period (β_1 in Table 3) were obtained by running the same specification, substituting (0, 1) multiplicative dummies for both of the subperiods. This technique was used to obtain second-period t-statistics in Tables 4 and 5 also.

16. All of the regressions in the paper (Tables 3-5) were run with and without the Credit Control period (March-July, 1980). The omission of these months made almost no perceptible difference, and so the regressions reported in the paper include the Credit Control period.

17. In work reported earlier, the author argued that such a shift might occur. (See footnote 7.)

18. TB in equation (2) is the 1-month return on a *new* 1-year Treasury bill held for one month only. Month-end effective yields (not discount yields) are from the DRI-FACS database with back data from Bank of America. The formula used to convert yields to monthly returns at monthly rates is:

$$\left\{ \left[\frac{1+\frac{Y_t}{100}}{1+\frac{Y_{t+1}}{100}} \right]^{11/12} - 1 \right\} \times 100.$$

19. It is known that for bonds with fixed coupons, the duration (the present-value-weighted effective maturity of all the payments—coupons and principal) varies inversely with the level of interest rates. This effect would alter a relationship between BK and coupon-bearing bonds, and thus would make interpretation of γ difficult. A T-bill has only a single payment at maturity and hence its duration is always its stated maturity, regardless of changes in the level of rates. The duration of TB at the beginning of each monthly holding period is a constant value of 12 months, regardless of the level of interest rates.

20. One has to take care in interpreting the higher t-statistics and lower standard error for the S&P 500 equation compared with the individual bank equations in Table 4. Part of the higher significance results from the fact that the S&P 500 index represents a diversified portfolio.

21. The perplexing behavior and interpretation of interest rates in the post-late-1979 period has been explored by Evans (1981) and others. His study and others do not fully explain post-1979 interest rate behavior.

22. There are several papers analyzing stock prices using orthogonalization, or more generally, principal components. All are subject to the criticism of overrated significance. (For an interpretation of these methods, see Fogler, John, and Tipton, 1981). Recently, papers by Flannery and James (1982 and 1983) have found significant effects of interest rates on bank stock prices. These papers use only that portion of stock market returns *orthogonal to debt returns* in an equation like that of equation (3). The measured interest rate elasticity is then the total effect (direct and through the stock market) of the interest rate on bank

stocks. Orthogonalization sidesteps the fact that SP and TB are jointly determined in a structural model of the economy. Besides overstating the resulting t-statistics, it ignores possible structural changes between these two important macroeconomic, endogenous variables. The significant shift variable in the S&P 500 equation in the bottom line of Table 4 indicates structural change between interest rates and the stock market between the two superiods.

23. The R^2 values are improved very little over those reported using beta alone (Table 3). F tests on the 91 individual bank regressions to test the significance of adding the interest rate parameters—i.e., testing for improved regression fit for the specification in Table 5 over that in Table 3—show critical F-values (95 percent confidence) in 25 of 91 cases.

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