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A Market-Based Risk Classification of Financial Institutions

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A Market-Based Risk Classification of Financial Institutions [1]

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Abstract: This paper derives, estimates, and analyzes a multi-factor model of the monthly holding period returns on the stocks of exchange-traded financial institutions. In addition to bond and equity returns, the factors include default, liquidity, and term structure risk premiums plus variables that measure changes in deposit demand. To ensure that our sample has a large number of firms, we use data from January 1981 through December 1988. The equity return explains a large share of time-series variation in financial institutions' returns. The additional factors implied by banking theory have little incremental explanatory power. The two-factor model regression coefficients have considerable cross-sectional variation. This permits us to group banks into portfolios with similar risk exposures. These portfolios bear no relation to the SIC codes that group banks by their charters and lines of business.

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A Market-Based Risk Classification of Financial Institutions

1.0 Introduction

A divergence exists between banking theory and banking econometrics. Banking theorists address the question of why banks are special. Two widely accepted answers are that banks reduce default and liquidity risks.[1] Empirical studies of banks' stock returns document the statistical significance of the two-factor model. One factor is the rate of return on the market portfolio, and the other factor is the return on a debt instrument.[2] While market and debt returns may be related to default and liquidity risks, their links have not been established. Consequently, we have banking theories that have not been closely tied to time series data, and banking evidence that has not been explicitly related to banking theory.

To reduce the gap between theory and evidence, we develop and estimate a model of the realized rate of return an investor receives from holding a financial institution's stock. The model includes the two-factor model as a special case. We use the results to provide evidence on three questions. First, we test for the effects of six types of risks on returns. For the most part, neither the default, liquidity, term structure, and deposit demand risk variables are significant. Only the equity return is consistently significant across banks. Second, we decompose the rate of return into an expected return and three different types of surprises. We estimate the additional return that stockholders demand for each type of risk exposure. We also estimate the effects of unexpected changes in economic conditions on banks' returns. Third, we examine differences in these effects across banks. A bank determines it's exposure to each of these risks by the compositions of its assets and liabilities, the off-balance sheet financial services it provides, and its hedging activities.[3] Banks differ greatly in their risk exposures, and their exposures are not closely related to the SIC-classifications of financial institutions. We group banks according to their estimated risk exposures.

[1] Bhattacharya and Thakor (1993) summarize much of the literature on this question.
[2] Neuberger (1991) summarizes and references many of the two-factor studies.
[3] We use bank generically to refer to banks and other financial institutions.

2.0 Framework

The value at date t, V_t, of a bank's expected perpetual cash flow, p , which it pays out entirely to its stockholders, is

$$V_t = \frac{E_t(p)}{k_t} \tag{1}$$

Here, k_t is the risk-adjusted, expected rate of return for the expected cash flow stream, $E_t(p)$.

When investors receive news that changes their estimate of the bank profits, or its cost of capital, they change their reservation price for the bank's stock. This changes the realized holding period rate of return, h_{t+1}, that the date-t equity investor at receives at date $t+1$. The holding period return is the sum of the realized cash distribution plus the change in the bank's value relative to its beginning-of-period value. Its realized distribution is its expected distribution plus the unexpected change in its current period cash flow. Its percent change in its value is the change in its expected profits minus the change in its cost of capital.[4]

$$h_{t+1} \equiv \frac{p_{t+1} + (V_{t+1} - V_t)}{V_t} \approx k_t + \frac{[p_{t+1} - E_t(p)]}{V_t} + \frac{E_{t+1}(p) - E_t(p)}{E_t(p)} - \frac{k_{t+1} - k_t}{k_t} \tag{2}$$

We next develop a relationship between each component of the holding period rate of return and variables that are exogenous to the bank. We then find data for the exogenous variables and estimate their effects on the bank's returns.

2.1 The bank's equity cash flow.

We model a bank as a price-taker in asset markets, and in its off-balance sheet activities, and a price-setter in the deposit market. It starts with B_t dollars of paid-in capital. At date t, the beginning of period t, it sets its deposit rate, $r_{d,t}$, to maximize its expected cash flow to equity. Savers compare this rate to the rate they can receive on deposit substitutes and allocate their savings between banks and securities. This determines the bank's deposits, D_t, and its interest expense. The bank uses these deposits

[4] Chen, Roll and Ross (1986) use this approach. See also Campbell, *et al*. (1997). The approximation is based on the ratio of k_{t+1} to k_t being close to one.

plus its capital to fund its assets, which consist of fixed-rate assets, F_t, and adjustable-rate assets, A_t.

$$A_t + F_t = D_t + B_t \tag{3}$$

The bank splits its assets between fixed- and adjustable-rate assets to maximize its interest revenue net of operating costs. The fixed-rate asset yields $r_{F,t}$, and the adjustable-rate yields $r_{a,t}$. Its off-balance sheet services, S_t, consist of origination, servicing, hedging, and transaction services with market price s_t per unit. It has operating costs, C, which depend on the quantities of its off-balance sheet activities and its assets. At date t, the bank's expected cash flow to equity to be delivered at date $t+1$ is[5]

$$E_t(\pi_{t+1}) = E_t(s_{t+1})S_t + E_t(r_{a,t+1})A_t + r_{F,t}F_t - r_{d,t}D_t - C(S_t, A_t, F_t) \tag{4}$$

The bank chooses the quantity of off-balance sheet activities it is willing to supply and its deposit rate to maximize its expected equity cash flow.

The interior first order conditions can be written as

$$E_t(s_{t+1}) = \frac{\partial C}{\partial S_t} \tag{5}$$

and either

$$r_{d,t} = E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - \frac{D_t}{\partial D_t / \partial r_{d,t}} \tag{6}$$

or

$$r_{d,t} = E_t(r_{F,t+1}) - \frac{\partial C}{\partial F_t} - \frac{D_t}{\partial D_t / \partial r_{d,t}} \tag{7}$$

[5] This is based on Santomero's (1984) survey of models of banks.

The two first-order conditions can be solved separately. Equation (5) shows that the bank supplies off-balance sheet activities in the quantity for which its marginal cost equals the market price of the service. Equation (6) shows that the cash-flow-maximizing deposit rate depends on the rate the bank earns on its adjustable-rate assets less its marginal operating costs less a term that represents interest expense sensitivity to the deposit rate. To solve this for the optimal deposit rate we must first state expressions for deposit demand and its derivative.[6]

2.2 Demand for deposits

Friedman and Roley (1987) study the conditions that give rise to asset demands that are linear in expected returns and homogeneous in wealth, *W*. If depositors have constant relative risk aversion, if the deposit rate is risk-free, and if the rate on a deposit substitute, r_s, is normally distributed, the expected utility maximizing deposit demand is

$$D_t = \{\alpha_0 + \alpha_1[r_{d,t} - E_t(r_{s,t+1})]\}W_t . \tag{8}$$

Deposit demand increases with the deposit rate, decreases with the rate on the deposit substitute, and increases with households' wealth. The coefficients α_0 and α_1 depend on depositors' risk aversions, and the variance of the return on the deposit substitute. A change in the deposit rate affects deposit demand according to

$$\frac{\partial D_t}{\partial r_{d,t}} = \alpha_1 W_t . \tag{9}$$

2.3. The optimized cash flow.

Substitute the deposit demand equation (8) and its derivative (9) into the first order condition (6), and solve for the equity-cash-flow-maximizing, market-equilibrium deposit rate. It is

[6] We use equation (6) in the ensuing analysis. Equation (7) gives equivalent results.

$$r_{d,t}^{*} = -\frac{\alpha_0}{2\alpha_1} + \frac{1}{2}[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} + E_t(r_{s,t+1})]. \tag{10}$$

The optimal deposit rate increases with the expected rate of return the bank can earn on its assets, and on the expected interest rate that depositors can earn on substitutes for the bank's deposits. It decreases with marginal operating costs of servicing assets.

Substitute the expression for the optimal deposit rate (10) back into the deposit demand equation (8) to obtain an expression for the market-equilibrium deposit demand. It is

$$D_t = \{\alpha_0/2 + \alpha_1/2[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - E_t(r_{s,t+1})]\}W_t \tag{11}$$

Deposit demand increases with the rate the bank earns on its assets net of its additional operating costs, decreases with the rate depositors can earn on deposit substitutes, and increases with wealth.

The purpose of the analysis thus far is to identify the exogenous variables that determine the bank's optimal equity-cash-flow. To this end, substitute the expression for the optimal deposit rate (10) and the expression for equilibrium deposit demand (11) into the cash flow equation (4).[7] This gives

$$\begin{aligned}
&E_t(p^{*}_{t+1}) = E_t(s_{t+1})S_t^{*} + E_t(r_{F,t+1})F_t^{*} \\
&+E_t(r_{a,t+1})\{B_t - F_t^{*} + \{\alpha_0/2 + \alpha_1/2[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - E_t(r_{s,t+1})]\}W_t\} \\
&-\{-\frac{\alpha_0}{2\alpha_1} + \frac{1}{2}[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} + E_t(r_{s,t+1})]\}\{\alpha_0/2 + \alpha_1/2[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - E_t(r_{s,t+1})]\}W_t \\
&-[C(S_t^{*}, B - F_t^{*} + \{\alpha_0/2 + \alpha_1/2[E_t(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - E_t(r_{s,t+1})]\}W_t, F_t^{*})]
\end{aligned}$$

[7] Without specifying a functional form for the cost function, we cannot get a closed-form solution for the optimal quantity of fixed-rate assets.

(12)

The exogenous variables in the optimized cash-flow-function (12) are the market-determined fees for each of the bank's off-balance sheet services, the interest rates the bank earns on its assets, the rates that banks' competitors pay on substitutes for bank deposits, and the aggregate wealth of savers. We use equation (12) in conjunction with equation (2) to analyze cross-sectional variation in banks' returns.

2.4. Effects of exogenous variables on the bank's expected cash flow

According to the holding period rate of return equation (2), if realized cash flows differ from expected cash flows, if expected cash flows change, or if the bank's cost of capital changes, the bank's realized rate of return differs from its expected rate of return.

The total derivative of the optimized cash-flow function gives an expression that explains changes in the bank's expected cash flow that occur between date *t* and date *t+1*. We assume that the bank responds optimally to these changes, and implements its responses at date *t+1* which is the beginning of the next period. We assume that investors are aware of the changes and the bank's optimal responses to them. Investors revise their expectations of the bank's expected cash flow from date *t+1* forward, and trade the bank's stock until its price at date *t+1* reflects their revised expectations.

$$dE(p^*) \approx \frac{\partial E(p^*)}{\partial E(s)} dE(s) + \frac{\partial E(p^*)}{\partial E(r_a)} dE(r_a) + \frac{\partial E(p^*)}{\partial E(r_F)} dE(r_F) + \frac{\partial E(p^*)}{\partial E(r_s)} dE(r_s) + \frac{\partial E(p^*)}{\partial W} dW \tag{13}$$

We use (12) to derive expressions for each of the partial derivatives in (13). We then analyze these expressions to predict cross-sectional variations in banks' responses to changes in the exogenous variables. This analysis assumes that each bank optimally adjusts to changes in the exogenous variables.

2.4.1. Effects of changes in the price of off-balance sheet services

Consider first the price of off-balance sheet services that banks supply. Their effect on the bank's expected cash flow is given by

$$\frac{\partial E_{t+1}(\pi_{t+2})}{\partial E_{t+1}(s_{t+2})} \approx S^*_{t+1} + [E_{t+1}(s_{t+2}) - \frac{\partial C}{\partial S_{t+1}}] \frac{\partial S^*_{t+1}}{\partial E_{t+1}(s_{t+2})} = S^*_{t+1} \equiv \alpha_s > 0 . \qquad (14)$$

If banks supply off-balance services in competitive markets, equation (5) requires that the price of each service equals its marginal cost, so the second term on the right-hand-side is zero. Thus, the change in the expected cash flow due to a change in the demand for off-balance sheet services equals the quantity of the service supplied by the bank. Banks differ in the amounts of each service they supply, and a single bank can change the amounts of services it supplies from one month to the next. To the extent that banks differ in the types and quantities of off-balance sheet services they supply, their returns will show different responses to changes in the prices of these services. We allow for these effects in our ensuing regression. However, since we do not allow our regression coefficients to change over the sample period, we are implicitly assuming that a bank does not make significant changes in the quantity of each service that it supplies.

Since we do not have data on service prices, we relate service price changes to changes in service demands. If demand increases, the price of the service increases above the average cost of supplying it and banks' cash flow increases. This lasts until banks collectively increase their supply of the service, and drive its price down to average cost. If demand decreases, the service price decreases below average cost and banks decrease production using their current facilities. With price less than average costs, some banks quit supplying the service and price rises until it equals average cost.

2.4.2. Effects of changes in returns on adjustable-rate assets[8]

[8] A similar analysis holds for changes in the return on the fixed-rate asset.

The next expression gives the response of the bank's expected cash flow to a change in the expected rate of return on an adjustable-rate asset.

$$\frac{\partial E_{t+1}(\pi_{t+2})}{\partial E_{t+1}(r_{a,t+2})} = A^{*}_{t+1} + \{[E_{t+1}(r_{a,t+2}) - \frac{\partial C}{\partial A^{*}_{t+1}}][\frac{\partial A^{*}_{t+1}}{\partial E_{t+1}(r_{a,t+2})} + \frac{\partial F^{*}_{t+1}}{\partial E_{t+1}(r_{a,t+2})}] - r^{*}_{d,t+1}\frac{\partial D^{*}_{t+1}}{\partial E_{t+1}(r_{a,t+2})}$$
$$- D^{*}_{t+1}\frac{\partial r^{*}_{d,t+1}}{\partial E_{t+1}(r_{a,t+2})}\} \equiv \alpha_{a} > 0 \qquad (15)$$

The first term on the right-hand-side, A^{*}_{t+1}, is the change in interest revenue from adjustable-rate assets that the bank already owns. The second term, the term in braces, is the change in net interest revenue from new assets. When the interest rate that a bank can earn on an asset changes, the bank responds by changing the rate they pay on their deposits. This leads depositors to change their deposit holdings. If an asset's return rises, the bank raises its deposit rate and gains more deposits. It allocates this new money between fixed- and adjustable-rate assets. It earns additional interest revenue on the new assets but incurs additional interest expense and has higher operating costs.

Banks differ in the fractions of their assets that are adjustable-rate as compared to fixed-rate, in how their costs respond to changes in activity, and how their depositors respond to changes in their deposit rates. These differences cause cross-sectional variations in the responses of banks' cash flows and returns to exogenous changes in the adjustable-interest rate.

2.4.3. Effects of changes in returns on deposit substitutes

When interest rates on assets that are substitutes for deposits change, the bank loses some deposits. This changes its interest expense. It responds by changing the rate it pays on deposits. This changes its deposit holdings with commensurate changes in its fixed- and adjustable-rate assets, interest revenue, interest expense, and operating costs.

$$\frac{\partial E_{t+1}(p^{*}_{t+2})}{\partial E_{t+1}(r_{s,t+2})} = \{[E_{t+1}(r_{a,t+2}) - \frac{\partial C}{\partial A^{*}_{t+1}}](\frac{\partial A^{*}_{t+1}}{\partial D^{*}_{t+1}} + \frac{\partial F^{*}_{t+1}}{\partial D^{*}_{t+1}}) - r^{*}_{d,t+1}\}\frac{\partial D^{*}_{t+1}}{\partial E_{t+1}(r_{s,t+2})}$$
$$-D^{*}_{t+1}\frac{\partial r^{*}_{d,t+1}}{\partial E_{t+1}(r_{s,t+2})} \equiv \alpha_{r_s} < 0 \qquad (16)$$

If banks differ in their market power in deposit markets, or in their operating costs, they have different responses to changes in rates paid on deposit substitutes.

2.4.4. Effects of changes in wealth

An increase in wealth increases deposit demand. The bank earns additional interest revenue on these new deposits but also incurs higher interest and operating expenses. The bank optimally responds by reducing the interest rate they pay on deposits. The term in braces on the right-hand-side of the following expression gives the increase in net interest revenue from increased deposits at the previously optimal deposit rate, and the second term gives the effect of an optimal change in the deposit rate.

$$\frac{\partial E_{t+1}(p^{*}_{t+2})}{\partial W_{t+1}} = \{[E_{t+1}(r_{a,t+2}) - \frac{\partial C}{\partial A^{*}_{t+1}}](\frac{\partial A^{*}_{t+1}}{\partial D^{*}_{t+1}} + \frac{\partial F^{*}_{t+1}}{\partial D^{*}_{t+1}}) - r^{*}_{d,t+1}\}\frac{\partial D^{*}_{t+1}}{\partial W_{t+1}} - D^{*}_{t+1}\frac{\partial r^{*}_{d,t+1}}{\partial W_{t+1}} \equiv \alpha_{W} > 0 \qquad (17)$$

Banks display cross-sectional variation in their responses to changes in wealth due to differences in their operating costs, and in how savers allocate their wealth between deposits and deposit-substitutes.

2.5. Surprises in the bank’s cash flow

Surprises differ from changes in expectations in that the bank is unable to respond optimally to surprises. Conditional on its forecasts of the exogenous variables, the bank makes its value-maximizing investment, financing, dividend and operating decisions at the beginning of each period. After the bank has made its decisions, the exogenous variables can take on values different from their expected values. We assume that the bank is unable to change its decisions in response to these surprises. We use the optimized cash-flow equation to derive the effects of surprises on the bank's actual cash flow.

2.5.1. Effects of surprises in the price of off-balance sheet services

Partially differentiate equation (12) with respect to the price of off-balance sheet services. The result is

$$\frac{\partial \pi_{t+1}}{\partial s_{t+1}} = S_t^* \equiv \alpha_s > 0. \tag{18}$$

Compare the responses of the bank's cash flow to changes in the actual and expected prices of off-balance sheet services. The bank's date *t* supply of financial services determines the response of its cash flow to a surprise in the price of financial services. In contrast, the bank's date *t+1* supply of services determines how a change in the expected price of services affects its cash flow. These responses differ by the change in the optimal supply of services between date I and date *t+1*. Thus, in principle, the response varies through time. In our empirical work we allow the responses to differ across banks, but require them to be constant through time for each group of banks.

2.5.2. Effects of surprises in the adjustable-rate

The partial derivative of the bank's cash flow with respect to the adjustable interest rate is

$$\frac{\partial \pi_{t+1}}{\partial r_{a,t+1}} = A_t^* \equiv \alpha_a^e < \alpha_a. \tag{19}$$

The bank receives the actual adjustable-rate, not the expected rate. Its revenues change in an amount equal to its holding of these assets times the change in their rate. Surprise changes in asset returns have smaller effects on cash flows than do changes in expected returns. This is because the bank is unable to respond optimally to surprises, but responds optimally to changes in expected returns.

2.5.3. Effects of surprises in the fixed-rate

The partial derivative of the bank's cash flow with respect to the fixed interest rate is

$$\frac{\partial \pi_{t+1}}{\partial r_{F,t+1}} = 0. \tag{20}$$

Surprises in the fixed rate have no effect on the bank's current cash flow as $r_{F,t+1}$ does not enter equation (12) for the bank's cash flow. Equation (20) is what we mean by a fixed-rate asset. It is one whose return is deterministic over the period.

2.5.4. Effects of surprises in returns on deposit substitutes

$$\frac{\partial \pi_{t+1}}{\partial r_{s,t+1}} = [E(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - r^*_{d,t}]\frac{\partial D_t}{\partial r_{s,t+1}} \equiv \alpha^e_{r_s} < \alpha_{r_s}. \tag{21}$$

Banks forecast the rate they expect their competitors to pay on deposit substitutes. On the basis of this forecast and forecasts of the other exogenous variables, banks set their deposit rate. Their forecast can be wrong. We assume that savers, but not the bank, optimally respond to a change in the rate that banks' competitors pay on deposit substitutes. If the rate rises, savers buy more of the substitute and less deposits. This reduces the bank's deposits, the quantity of assets it can fund, its interest expense and its interest revenue net of operating costs. Since net revenue exceeds the deposit rate, the bank's cash flow decreases.

2.5.5. Effects of wealth surprises

$$\frac{\partial \pi_{t+1}}{\partial W_{t+1}} = [E(r_{a,t+1}) - \frac{\partial C}{\partial A_t} - r^*_{d,t}]\frac{\partial D_t}{\partial W_{t+1}} \equiv \alpha^e_W < \alpha_W . \qquad (22)$$

A change in wealth changes savers' demands for deposits. If wealth increases, deposit demand increases. The bank allocates the deposits between adjustable- and fixed-rate assets. Its interest revenue, operating costs, and deposit expenses all increase. Their net effect is to increase the bank's cash flow.

2.6. Changes in the cost of capital

The two-factor model relates the bank's cost of equity capital to the expected return on the market portfolio of stocks, $E_t(r_{m,t+1})$, and the expected holding period return on default-free bonds, $E_t(r_{B,t+1})$. In addition, we add premiums for default risk, liquidity risk, and term structure risk. Risk exposure has a two-pronged effect on a bank's financial performance. If the bank properly charges its customers for managing risk, its expected cash flow rises with its risk bearing. But, so does its cost of capital as its stockholders demand to be compensated for the risk they bear. A bank that intentionally increases its risk exposure and properly charges for risk management will not have a change in its market value.

Each risk premium is the product of the bank's risk exposure to the *ith* type of risk, β_i, times the market price of that type of risk, λ_i. The bank's equity cost of capital at date *t*, the beginning of the holding period, is

$$k_t = E_t(r_{m,t+1}) + E_t(r_{B,t+1}) + \sum_{i=1}^{3} \beta_i \lambda_{i,t} \qquad (23)$$

Each component of the cost of capital can change over the holding period from date *t* to date *t+1*. To be able to estimate the bank's risk exposures, we assume the bank's risk exposures, the b s, are constant over the sample period. The next equation gives the effects of changes in the exogenous components on the bank's cost of capital.

$$dk_{t+1} = dE_{t+1}(r_{m,t+2}) + dE_{t+1}(r_{B,t+2}) + \sum_{i=1}^{3} b_i dl_{i,t+1} \,. \tag{24}$$

2.7. Summary of factors affecting the bank's rate of return

The various factors influencing a bank's holding period return is summarized in the following equation.

$$\begin{aligned} & h_{t+1} \approx E_t(r_{m,t+1}) + E_t(r_{B,t+1}) + \sum_{i=1}^{3} b_i l_{i,t} \\ & + V_t^{-1}[a_s^e e(s_{t+1}) + a_a^e e(r_{a,t+1}) - a_{r_s}^e e(r_{s,t+1}) + a_W^e e(W_{t+1})] \\ & + E(p_t^*)^{-1}[a_s dE_{t+1}(s_{t+2}) + a_a dE_{t+1}(r_{a,t+2}) - a_{r_s} dE_{t+1}(r_{s,t+2}) + a_W dW_{t+2}] \\ & - k_t^{-1}[dE_{t+1}(r_{m,t+2}) + dE_{t+1}(r_{B,t+2}) + \sum_{i=1}^{3} b_i dl_{i,t+1}] \end{aligned} \tag{25}$$

The realized rate of return equals the expected rate of return, k_t, plus unexpected changes in the bank's profits over the period due to forecast errors in the exogenous variables, plus news about future expected profits, minus news about the bank's cost of capital.

We can condense the expression for the bank's realized equity rate of return by noting that the same exogenous factors affect the bank's loan rate, and investors' required return on the bank's equity. Each of these rates is the sum of a risk-free rate plus risk premiums.

The loan rate equals the risk-free rate plus premiums for the default risk of the borrower, the illiquidity of the loan, and perhaps a term premium to compensate the lender for term structure risk. Each premium is the product of the risk of the loan and the market price of that type of risk.

$$E_t(r_{a,t+1}) = r_{f,t} + b_d l_{d,t} + b_l l_{l,t} + b_T l_{T,t} \tag{26}$$

Substituting (26) into equation (25) gives the regression equation that explains the realized rate of return on the bank’s stock.

$$\begin{aligned}
&h_{t+1} \approx E_t(r_{m,t+1}) + E_t(r_{B,t+1}) + \sum_{i=1}^{3} b_i l_{i,t} \\
&+V_t^{-1}[a_s^e e(s_{t+1}) + a_a^e e(r_{a,t+1}) - a_{r_s}^e e(r_{s,t+1}) + a_W^e e(W_{t+1})] \\
&+E(p_t^*)^{-1}[a_s dE_{t+1}(s_{t+2}) + a_a dr_{f,t+1} - a_{r_s} dE_{t+1}(r_{s,t+2}) + a_W dW_{t+2}] \qquad (27) \\
&-k_t^{-1}[dE_{t+1}(r_{m,t+2}) + dE_{t+1}(r_{B,t+2})] \\
&+[E(p_t^*)^{-1} a_a - k_t^{-1}] \sum_{i=1}^{3} b_i dl_{i,t+1}]
\end{aligned}$$

The first row on the right-hand-side is the expected rate of return that investors require at date *t*, the beginning of the month, to hold the bank’s stock until date *t+1*, the end of the month. The remaining terms represent unexpected changes in the rate of return. The second row is the unexpected change in the bank’s cash flow between date *t* and *t+1* due to errors that investors made in forecasting the variables that drive the cash flow. The third row shows the effects of changes that occur during period *t* in the expected values of the exogenous variables that drive cash flows. The fourth row is the effect of changes in the bank’s cost of capital that occur during period *t*. The last row shows the effects of variables that affect the bank’s rate of return through both cash flows and the cost of capital. These are changes in the market premiums for default risk, liquidity risk, and term structure risk.

3.0. Data

To form our data set we searched Compustat for all firms with SIC codes between 6000 and 6299. These include commercial banks and deposit institutions, non-deposit credit institutions, and organizations involved in security trading. For the time period January 1981 through December 1988 we found 64 firms with stock that traded on either the NYSE or AMEX and 117 firms whose stock was traded on the NASDAQ.[9] We excluded one stock from the NYSE sample because it was an ADR. We obtained each firm's daily holding period return including any distribution from the CRSP daily return file. We removed a firm from the data set if the number of missing returns in any month exceeded 20 percent of the trading days in the month. This criterion led us to remove one of the NYSE/AMEX firms and 12 of the NASDAQ firms. This left us with 167 firms: 124 commercial banks, 15 savings institutions, 5 non-deposit credit institutions, 11 security brokers and investment advisers, and 12 others. For each of these firms we compounded their daily returns into monthly returns.

Table 1 reports how we measure each of the regressors.

4.0. Empirical Results

4.1. Procedures

We conducted our empirical analysis in four steps. First, to align the data with the theoretical model of returns, we estimated an ARIMA model for each regressor using monthly data over the five years from 1976 through 1980.[10] We reestimated the coefficients of the model each month using the last five years of data up to that month.[11] We use the predicted values, their forecast errors, and the changes in the predicted values as the empirical measures of the theoretical variables in equation (27). Second, we estimated the rate of return equation (27) for each firm in the data set. Third, we use a portfolio approach to conduct hypothesis tests. We entered the estimated regression coefficients into SAS's version of Ward's minimum-variance-clustering procedure and grouped the firms into ten clusters. Fourth, for each cluster we formed an equally-weighted portfolio of the returns on the firms in the cluster. We then regressed each portfolio return on the regressors in equation (27).

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[9] When we extended our sample period past the end of 1988, we lost many banks from the sample because of bank mergers and acquisitions.

[10] We also estimated an ARIMA model for each regressor using data from 1981-1988. The results do not change significantly.

[11] We do not allow the structure of the ARIMA process to change each month. We only permit the coefficients of the model to change.

4.2. Hypothesis tests

Our main concern in this paper is to test whether the variables representing default, liquidity, term structure, and deposit demand risks have incremental explanatory power for banks' returns.[12] We start with the two-factor model that previous researchers have found describes returns to banks' stockholders.[13] In our setup, the two-factor model has six regressors.[14] For each factor we enter its predicted value, its forecast error, and the change in its predicted value. Table 2 reports the results. The prediction error in the CRSP return is the only regressor that is significant in each of the ten portfolios.[15] It explains a significant portion of the portfolio returns for all ten portfolios. Financial institutions have heterogeneous responses to the CRSP-return prediction error. Coefficients range from a low of 0.8 to a high of 1.5.

To test the multi-factor model of banks' returns, we add 13 additional regressors which comprise four variables to measure changes in deposit demand, three to represent default risk, three for liquidity risk, and three for term structure risk.[16] We reestimate the regression coefficients for each bank, cluster the banks into ten new portfolios, and reestimate the multi-factor model for each portfolio. Table 3 reports the estimates. A visual examination of the table shows that the CRSP prediction error is strongly significant for each portfolio, and the components of the bond return are significant in only four portfolios. The additional factors are infrequently significant.

Our main result, reported in Table 4, is a test of hypothesis 1, *H1*. As a group the thirteen additional regressors are significant in only three portfolios at a p-value of 10 percent or less.[17] The multi-factor model of banks' returns adds little to the two-factor model. For all of the portfolios, see *H2*, the two-factor regressors are strongly significant in the presence of the additional factors. This suggests that the two-factor model, not the

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[12] We are particulary interested in these variables because these are the risks that banks manage for the economy. See the readings in James and Smith (1994) and the discussion in Greenbaum and Thakor (1995).

[13] See Neuberger, *op. cit.*

[14] Our model nests the standard two-factor model.

[15] The predicted value of the CRSP and bond returns from our ARIMA models are poor predictors of the actual returns. Consequently, the forecast errors are approximately the monthly changes in the returns.

[16] The 20-year bond return may also represent some of the interest rate risk.

[17] Portfolios 9 and 10 contain 2 and 1 firms respectively. We do not view their results as informative.

default-*cum*-credit-*cum*-term structure-*cum*-deposit risk model, should be the benchmark model of banks' returns. Banking theory has little explanatory power for financial institutions' returns over a general two-factor model that applies to nonfinancial firms.

We next ask whether we can eliminate any of the thirteen regressors to obtain a simpler empirical model of banks' returns. A prime theoretical possibility is that banks' returns are explained by just their expected returns. To test this we drop all regressors except for the predicted values of the CRSP return, the bond return, and the premiums for default, liquidity, and term structure risk, see *H3*. All ten portfolios reject this hypothesis. The components of expected holding period returns do not explain banks' stock returns.

At the other extreme, we drop all the regressors that represent surprises, see *H4*. The surprise regressors are the prediction errors and the changes in the predicted regressors. The data reject this hypothesis for all ten portfolios. Surprises in the factors, primarily the equity-return surprise, explain most of the variation in banks' returns.

We now test sets of regressors as they are organized in equation (27). The first line of equation (27) contains regressors that represent the expected holding period return on the portfolio of banks' stocks. Hypothesis 5, *H5*, tests whether we can drop these variables. We can for seven of the ten portfolios at a p-value of 10 percent. This reinforces the finding from *H3*. Expected holding period returns explain little of realized returns. The second and third lines of equation (27) show the effects of cash flow surprises on returns. Hypothesis 6, *H6*, asks if we can drop these regressors. The answer is yes for eight of the ten portfolios at a p-value of 10 percent. Investors pay little attention to cash flow surprises in setting prices for banks' stocks. Finally, hypothesis 7, *H7*, asks whether we can drop the regressors in lines four and five of equation (27). These are the surprises in the cost of capital and risk premiums. The answer is no for five of the ten portfolios at a 10 percent p-value. Cost of capital surprises explain most of the variations in banks' returns. Surprises in the CRSP return are the most important component of cost of capital surprises.

4.2. Portfolio Results

Because the multi-factor model does not have significant incremental explanatory power over the two-factor model, we use the two-factor results in Table 2 to study cross-sectional differences in banks' returns.[18] To interpret the results it is useful to review the dating of the components of the return variables. We imagine an investor at date *t* allocating his or her money between bank stocks and other assets. Their trades set date-*t* equity prices. The higher these prices, the lower is the rate of return during the month beginning at date *t* and ending at date *t+1*. During the period, investors receive news that causes them to revise their date *t+1* expectation of banks' returns. If they revise upward their expectations, they bid up the date *t+1* prices of banks' stocks. This raises the holding period rate of return from date *t* to date *t+1*.

Bond returns have little or no effect on portfolios 1, 2, 3, and 5. These portfolios contain 100 of our sample of 167 firms. A single-factor, equity-return model explains time series variations in these firms' returns. Investors appear to have considered these financial institutions to have been duration balanced. Bond returns, in varying degrees, affect the other six portfolios which contain the remaining 67 firms.

The coefficients of the change in the predicted bond return are all negative. If bond returns increased over the last five years, our ARIMA model predicts them to increase next month.[19] For expected bond returns to increase, bond yields must fall by a larger amount than they fell in the past. Our results show that when investors expect a large decrease in bond yields they bid up the prices of banks' stocks. This causes the date *t* holding period return to increase. Based on the negative sign of the coefficient of the change in the predicted bond return, investors viewed the banks in portfolios 4 and 7 as being long-funded.

If bond yields fall unexpectedly during month *t*, bond returns rise unexpectedly during the month. Investors bid up the prices of the banks in portfolios 4, 6, and 7. This is consistent with investors viewing these banks as being long-funded.

Predicted bond returns affect the banks in portfolios 8, 9, and 10. These portfolios contain only seven banks in total. If bond returns have been high for the past five years,

[18] The appendix reports the firms in each of the ten portfolios.

[19] The change in the predicted bond return is approximately the change in the average bond return for the five years ending at date *t+1* minus the average bond return for the five years ending at date *t*.

their predicted return for the current month is high.[20] For past returns to have been high, yields must have fallen. If the predicted return is high, the predicted yield is falling. All significant coefficients of the predicted bond returns are negative. Thus, banks' returns are positively related to expected changes in bond yields. Investors must view the banks in portfolios 8, 9, and 10 as being long funded. When investors expect yields to fall, they bid up the prices of these banks and bid down their returns. Investors must think that a fall in yields is bad for these banks. This is the case if the banks are long-funded.

Because the coefficients in our ARIMA model of the CRSP return are insignificant, the predicted CRSP return is its average value over the five years prior to date *t*. The prediction error in the CRSP return is approximately the difference between the actual return and its previous five-year average. Since the average changes slowly, the prediction error behaves approximately as the actual return. All prediction error coefficients are significantly positive. When investors receive news that causes them to bid up the prices of the stocks in the CRSP index, this news also causes them to bid up the prices of banks' stocks. We do not know what this news is. But, based on our finding that the additional factors do not explain variation in banks' returns, they do not seem to be news-worthy variables for investors to attempt to anticipate.

5.0 Comparison with Standard Industrial Classifications

Financial intermediaries provide a variety of financial services to savers and investors: they reduce the costs of searching for counterparties; they value assets and liabilities; they report prices which aids the price discovery process; they monitor borrowers; they provide denomination and maturity intermediation; they eliminate unsystematic risk through diversification; they hedge their own risks and manage the risks of others; they provide liquidity; and they provide the payment system. In providing these services banks are exposed to a variety of risks. Their exposures to these risks provides a way to categorize banks.

[20] The ARIMA model for bond returns has a positive, but insignificant moving-average term. The predicted bond return is approximately the average bond return over the past five years.

Banks can also be categorized by their regulatory status. In principle, the economic and regulatory categories should be related as regulations attempt to restrict the assets and liabilities that banks can issue and own, and their off-balance sheet activities. A bank's balance sheet and off-balance sheet activities determines its risk exposures and the return that investors require to own the bank's stock. In practice, regulatory classifications do not provide an accurate description of banks' economic activities as reflected in their risk exposures. Table 5 compares the SIC classifications of banks with our risk-based classifications. There are no discernible patterns between risk and charter category.

6.0 Conclusions

The equity return explains a large share of the time series variation in financial institutions' monthly stock returns. The holding period return on long-term treasury bonds has incremental explanatory power for 67 of the firms in our sample of 100. Financial institutions display considerable cross-sectional variation in their responses to these factors. These responses bear little relation to their SIC classification. Financial institutions' returns show little response to premiums for liquidity, default, term structure risk, and deposit demand risks. Financial institutions have immunized their values against risks not captured by the equity premium. From an investor's risk perspective, financial firms are little different from non-financial firms.

Risk exposure has a two-pronged effect on a bank's financial performance. If the bank charges its customers for managing their risks, its expected cash flows rise with the amount of risk it bears. But, so does its cost of capital as stockholders demand compensation for bearing risk. A bank that increases its risk exposure and charges the market risk premium will not have a change in its value. Our results are consistent with banks being astute risk managers. Astuteness can explain why their returns are not affected by changes in risk premiums.

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Appendix

Clustering Procedure

Our regression equation, be it a two-factor model or a multi-factor model, serves as a basis for producing the clustering result. First, we estimate the coefficients of the model for an individual bank using a time-series of stock returns over 1981 to 1988 sample period. Second, for each pair of banks, we perform an f-test, whose null hypothesis is that all the model's coefficient estimates of the pair of banks are identical. The resulting f-statistic serves as a measurement of how different a pair of banks are from each other. Under the null hypothesis, if both banks respond similarly to all factors, the f-statistic should be zero. Otherwise, the size of the f-statistic approximately indicates the dissimilarity of banks' sensitivity to the factors. We perform this test on all combination of banks in our sample. We use these f-test results to form a lower triangular matrix. A typical element (i, j), where i < j, stores the f-statistic from the mentioned hypothesis testing between bank i and bank j.

We use the matrix of f-statistics as a distance matrix for the clustering procedure. We use Ward's minimum variance clustering procedure. This procedure is a part of SAS/ETS software package. Ward's minimum variance method belongs to a class of hierarchical clustering procedures. In short, the procedure attempts to group a number of observations so as to minimize the objective function, which equals the summation of variance of intra-cluster distance. The minimization routine works iteratively. During each iteration, the procedure combines any two existing clusters that produces the smallest value of the objective function. At the end of each iteration, the number of clusters is reduced by one. The procedure continues until the number of clusters equals one. Since the procedure stores the clustering outcomes of all iterations, we obtain our result by simply recording the outputs from the iteration where the number of resulting clusters is ten.

Time-series Model Fitting

We use the Box-Jenkins framework to fit time-series models to our data series. We use Schwarz's information criterion to determine the best fitted model. We perform the model selection procedure during the 60-month period between November 1975 to October 1980. The model fitting period does not immediately precede our sample period. The reason for this gap is the two-month reporting lag in the leading indicator data series.

We use the chosen models to construct series of forecasts of all independent variables. While the model specifications remain fixed throughout the sample period, we re-estimate the parameters of the models using the sample from a 60-month period immediately prior to the data points we wish to produce forecasts. This 60-month moving window allows us to produce series of forecasts for our 1981 to 1988 sample period.

In choosing the time-series specification, we require that we be able to estimate the models for all periods in our sample. This requirement causes us to drop the best fitted model for the liquidity risk premium series. The final model for this series is in fact the third best fitted model. In this case, we are unable to estimate the parameters of the better fitted models in some periods in our sample. The following lists the models we fit to our data series.

Data series	Time-series model
Leading indicator	AR(2)
20-year Treasury bond holding period return	MA(1)
3-month Treasury bill yield	AR(2)
Credit risk premium	AR(1)
Term premium	ARMA(1,1)
Liquidity risk premium	ARMA(1,3)
Market return	MA(1)

Table 1. Regressors

Variable	Theoretical Role	Regressors
Risk-free interest rate, r_B	Rate of return that investors can earn on a default-free asset as an alternative to holding bank stocks.	Monthly holding period rate of return on 20-year maturity, U.S. treasury bond. From Dimensional Fund Advisors. Our choice of the 20-year rate is based on Kane and Unal's (1988) findings.
Market return, r_m	Rate or return that investors receive for holding equity.	Monthly holding period return on CRSP value-weighted, equity portfolio.
Default risk premium, l_d	Premium that investors receive for bearing default risk.	BAA bond yield minus AAA bond yield. Bond yield data are from Citibase. We also tried the yield on three-month CDs minus the yield on the corresponding three-month treasury bill. CD and bill yield data are from Avraham Kamara. We discarded this because the three-month bill rate appeared in other risk premiums.
Liquidity risk premium, l_l	Premium that investors receive for bearing liquidity risk.	Interest rate on three-month federal agency securities minus interest rate on three-month U.S. treasury bills. We also tried the yield on bankers' acceptances minus the bill yield. We discarded this because of lack of data for the entire estimation period. All yield data are from Avraham Kamara.
Term premium, l_T	Premium that investors receive for being exposed to term structure risk.	Yield on one-year treasury bill minus yield on six-month treasury bill Data are from Citibase. We also tried the 10-year treasury bond yield minus the three-year treasury note yield using data from Citibase.
Change in leading indicator, $dE(S)$	Represents news about the demand for banks' services which leads to changes in banks' expected cash flows. Also represents changes in savers' wealth which changes their demand for deposits.	Seasonally adjusted index from Citibase.
Change in short-term, risk-free rate, dr_f	Represents news about the interest rates that depositors can earn on substitutes for banks' deposits. Leads investors to change their forecasts of banks' cash flows.	Three-month treasury bill yield from Avraham Kamara.

TABLE 2. FINANCIAL INSTITUTIONS RATE OF RETURN REGRESSIONS (TWO-FACTOR MODEL)
JANUARY 1981 THROUGH DECEMBER 1988

		Portfolio									
	mean	1	2	3	4	5	6	7	8	9	10
Constant	1.0	0.04 (0.98)	2.10 (0.12)	1.50 (0.15)	1.20 (0.25)	3.39 (0.01) **	-3.38 (0.08) *	4.38 (0.03) **	-1.42 (0.70)	3.01 (0.33)	16.48 (0.06) *
Predicted 20-year T-bond return	0.90	-0.38 (0.51)	-0.15 (0.81)	-0.58 (0.23)	-0.52 (0.28)	-0.77 (0.18)	-0.32 (0.72)	-0.75 (0.41)	-5.54 (0.00) ***	-2.46 (0.08) *	-6.97 (0.08) *
Change in predicted 20-year T-bond return	0.01	-0.82 (0.38)	-0.75 (0.44)	-1.06 (0.17)	-1.90 (0.02) **	-0.76 (0.41)	-1.77 (0.22)	-5.89 (0.00) ***	-3.49 (0.21)	-1.51 (0.51)	1.70 (0.79)
Prediction error of 20-year T-bond return	0.29	0.11 (0.30)	0.22 (0.06) *	0.14 (0.14)	0.23 (0.02) **	0.15 (0.16)	0.34 (0.05) **	0.46 (0.01) ***	-0.33 (0.32)	0.39 (0.15)	-0.94 (0.22)
Predicted equity return	1.37	1.13 (0.24)	0.40 (0.69)	0.48 (0.55)	0.92 (0.25)	-0.32 (0.74)	3.01 (0.04) **	-0.31 (0.83)	3.61 (0.21)	-1.22 (0.60)	-3.64 (0.58)
Change in predicted equity return	-0.01	0.10 (0.90)	-0.22 (0.79)	-0.67 (0.30)	-0.31 (0.64)	-0.92 (0.23)	0.27 (0.82)	-0.67 (0.59)	-0.52 (0.82)	-0.31 (0.87)	-0.49 (0.93)
Prediction error of equity return	-0.19	1.00 (0.00) ***	0.82 (0.00) ***	0.89 (0.00) ***	0.84 (0.00) ***	0.86 (0.00) ***	1.13 (0.00) ***	1.05 (0.00) ***	1.50 (0.00) ***	1.01 (0.00) ***	1.26 (0.01) ***
Adjusted R^2		0.75	0.67	0.77	0.75	0.71	0.61	0.60	0.36	0.40	0.07
Durbin Watson		2.17	2.11	2.04	1.91	2.05	2.22	2.01	2.53	2.45	2.01
Average monthly return (%)		1.07	2.41	1.50	1.88	2.15	0.31	3.17	-1.88	-0.96	4.73
Standard deviation		5.60	5.17	4.92	4.72	5.15	7.02	6.99	10.49	8.92	20.11
Number of banks	167	22	34	31	42	13	11	7	3	3	1

Note: * denotes significance at 10% level
** denotes significance at 5% level
*** denotes significance at 1% level

TABLE 3. FINANCIAL INSTITUTIONS RATE OF RETURN REGRESSIONS (MULTI-FACTOR MODEL)
JANUARY 1981 THROUGH DECEMBER 1988

		Portfolio									
	mean	1	2	3	4	5	6	7	8	9	10
Constant	1.0	1.89 (0.59)	-0.50 (0.89)	0.97 (0.75)	-0.63 (0.84)	-2.99 (0.29)	-3.77 (0.48)	-19.7 (0.01) **	-15.3 (0.04) **	-12.0 (0.01) **	6.99 (0.31)
Two-factor model coefficients											
Predicted 20-year T-bond return	0.90	-0.73 (0.49)	0.70 (0.53)	0.64 (0.50)	0.55 (0.57)	1.61 (0.07) *	-2.73 (0.10)	3.20 (0.19)	-2.75 (0.23)	0.31 (0.83)	-4.54 (0.04) **
Change in predicted 20-year T-bond return	0.01	-3.06 (0.01) **	-1.19 (0.35)	-0.99 (0.37)	0.45 (0.69)	2.78 (0.01) ***	-0.93 (0.63)	2.50 (0.37)	0.40 (0.88)	1.81 (0.27)	-8.07 (0.00) ***
Prediction error of 20-year T-bond return	0.29	0.49 (0.00) ***	0.29 (0.05) **	0.20 (0.11)	-0.05 (0.68)	-0.30 (0.01) **	-0.28 (0.20)	0.97 (0.00) ***	-0.14 (0.64)	-0.08 (0.65)	0.26 (0.36)
Predicted equity return	1.37	1.17 (0.35)	-1.12 (0.39)	-0.18 (0.87)	-0.87 (0.45)	0.03 (0.97)	2.33 (0.24)	0.95 (0.74)	1.28 (0.63)	2.26 (0.18)	-2.21 (0.38)
Change in predicted equity return	-0.01	0.05 (0.96)	-1.13 (0.23)	-1.58 (0.05) *	-1.21 (0.15)	0.07 (0.92)	1.31 (0.35)	2.17 (0.29)	-0.06 (0.97)	-0.96 (0.43)	-2.53 (0.16)
Prediction error of equity return	-0.19	0.98 (0.00) ***	0.79 (0.00) ***	0.53 (0.00) ***	0.73 (0.00) ***	0.33 (0.00) ***	1.22 (0.00) ***	1.21 (0.00) ***	1.89 (0.00) ***	1.25 (0.00) ***	1.29 (0.00) ***
Deposit demand coefficients											
Change in leading indicator	0.10	-1.72 (0.39)	0.02 (0.99)	2.85 (0.11)	-0.80 (0.66)	-1.70 (0.29)	-4.67 (0.13)	-1.13 (0.80)	-0.18 (0.97)	-0.94 (0.72)	-1.39 (0.73)
Prediction error of leading indicator	0.06	2.89 (0.30)	1.68 (0.56)	-3.39 (0.18)	1.22 (0.63)	2.33 (0.30)	6.67 (0.13)	3.12 (0.62)	0.51 (0.93)	0.80 (0.83)	1.21 (0.83)
Change in predicted 3-month T-bill rate	-0.05	4.52 (0.45)	5.54 (0.37)	5.75 (0.27)	4.89 (0.37)	2.26 (0.63)	10.70 (0.25)	9.44 (0.48)	1.76 (0.89)	13.65 (0.09) *	9.06 (0.45)
Prediction error of 3-month T-bill rate	-0.11	-4.55 (0.45)	-5.42 (0.38)	-6.32 (0.24)	-3.59 (0.51)	-2.01 (0.68)	-10.6 (0.26)	-8.85 (0.51)	-3.36 (0.79)	-13.6 (0.09) *	-11.6 (0.33)

TABLE 3 (CONT.). FINANCIAL INSTITUTIONS RATE OF RETURN REGRESSIONS
JANUARY 1981 THROUGH DECEMBER 1988

		Portfolio									
	mean	1	2	3	4	5	6	7	8	9	10
Credit, liquidity, and term structure risk coefficients											
Predicted credit risk premium	1.54	-1.75 (0.32)	1.81 (0.32)	-0.60 (0.70)	1.40 (0.38)	1.50 (0.29)	0.80 (0.77)	9.23 (0.02) ***	8.79 (0.02) ***	4.60 (0.05) **	2.00 (0.57)
Change in predicted credit risk premium	-0.01	-6.96 (0.50)	-2.23 (0.84)	0.25 (0.98)	7.00 (0.46)	0.89 (0.92)	-11.4 (0.48)	17.41 (0.46)	31.37 (0.16)	-10.6 (0.44)	-5.98 (0.77)
Prediction error of credit risk premium	-0.01	7.54 (0.53)	1.07 (0.93)	-4.49 (0.68)	-6.45 (0.56)	-0.49 (0.96)	20.38 (0.28)	-18.1 (0.51)	-28.3 (0.27)	15.15 (0.35)	5.40 (0.82)
Predicted term premium	0.00	-4.79 (0.20)	-1.96 (0.61)	-7.65 (0.02) **	-4.85 (0.15)	-6.36 (0.04) **	-6.48 (0.26)	-1.58 (0.85)	0.26 (0.97)	-2.06 (0.68)	4.22 (0.57)
Change in predicted term premium	0.02	-10.2 (0.38)	3.47 (0.77)	-19.0 (0.07) *	-14.2 (0.18)	-15.8 (0.10) *	-12.3 (0.49)	2.38 (0.93)	-4.35 (0.86)	-3.47 (0.82)	15.35 (0.51)
Prediction error of term premium	0.04	8.47 (0.58)	-2.95 (0.85)	23.0 (0.09) *	13.47 (0.33)	17.07 (0.17)	9.77 (0.68)	9.25 (0.79)	-2.07 (0.95)	-2.91 (0.88)	-30.2 (0.32)
Predicted liquidity risk premium	0.23	5.62 (0.26)	-0.01 (1.00)	2.54 (0.56)	3.56 (0.43)	1.92 (0.63)	5.58 (0.47)	6.24 (0.58)	17.09 (0.10)	12.52 (0.06) *	3.31 (0.74)
Change in predicted liquidity risk premium	0.00	5.29 (0.22)	-3.29 (0.47)	1.40 (0.72)	1.42 (0.72)	-5.46 (0.12)	6.86 (0.31)	6.07 (0.54)	5.03 (0.58)	2.67 (0.64)	-0.50 (0.95)
Prediction error of liquidity risk premium	0.03	0.79 (0.68)	0.23 (0.91)	0.32 (0.85)	0.60 (0.73)	0.11 (0.94)	0.86 (0.78)	3.13 (0.48)	2.04 (0.62)	4.68 (0.07) *	-0.28 (0.94)
Adjusted R^2		0.73	0.66	0.52	0.63	0.35	0.59	0.64	0.70	0.73	0.57
Durbin Watson		2.08	1.93	1.78	2.04	1.85	2.36	2.25	2.23	2.17	2.12
Average monthly return (%)		1.73	1.71	2.00	1.94	1.55	-0.34	1.35	1.37	1.69	3.40
Standard deviation		5.90	5.45	3.92	4.54	3.07	7.36	11.52	11.88	7.74	9.34
Number of banks	167	36	23	16	34	20	9	9	4	11	5

Note: * denotes significance at 10% level
** denotes significance at 5% level
*** denotes significance at 1% level

TABLE 4. HYPOTHESIS TESTING RESULTS
JANUARY 1981 THROUGH DECEMBER 1988

Null Hypothesis	Portfolio									
	1	2	3	4	5	6	7	8	9	10
H1: All non-market model coefficients are zero.	0.55 (0.88)	1.10 (0.37)	1.66 (0.09) *	1.23 (0.28)	1.76 (0.07) *	0.63 (0.82)	1.21 (0.29)	1.60 (0.10)	1.82 (0.05) *	1.47 (0.15)
H2: All market model coefficients are zero. (All T-bond and equity variables)	36.35 (0.00) ***	23.48 (0.00) ***	12.51 (0.00) ***	22.82 (0.00) ***	6.47 (0.00) ***	17.92 (0.00) ***	20.00 (0.00) ***	26.07 (0.00) ***	28.38 (0.00) ***	15.26 (0.00) ***
H3: All forecast error and change in predicted value coefficients are zero.	30.64 (0.00) ***	18.45 (0.00) ***	12.30 (0.00) ***	18.13 (0.00) ***	5.28 (0.00) ***	16.76 (0.00) ***	11.43 (0.00) ***	20.97 (0.00) ***	24.76 (0.00) ***	11.66 (0.00) ***
H4: All forecast error coefficients are zero.	20.06 (0.00) ***	13.4 (0.00) ***	8.19 (0.00) ***	12.35 (0.00) ***	4.40 (0.00) ***	10.23 (0.00) ***	12.38 (0.00) ***	13.90 (0.00) ***	17.97 (0.00) ***	7.54 (0.00) ***
H5: All expected holding period return coefficients are zero. (All predicted cost of capital variables *k*)	1.41 (0.23)	0.61 (0.69)	1.55 (0.19)	0.91 (0.48)	1.17 (0.33)	2.94 (0.02) **	1.52 (0.19)	2.24 (0.06) *	2.25 (0.06) *	1.79 (0.12)
H6: All coefficients of cash flow prediction errors are zero. (All error prediction variables except equity return)	2.36 (0.04) **	1.46 (0.21)	1.41 (0.22)	0.48 (0.82)	1.48 (0.20)	0.62 (0.71)	2.19 (0.05) *	0.39 (0.88)	0.93 (0.48)	0.47 (0.83)
H7: All coefficients of changes in expectation of future cash flow variables are zero. (All changes in predicted terms and all prediction error terms except T-bill and leading indicator)	1.27 (0.25)	1.17 (0.32)	1.86 (0.05) *	0.94 (0.51)	1.95 (0.04) **	1.72 (0.08) *	0.94 (0.51)	1.42 (0.17)	2.32 (0.01) **	2.05 (0.03) **

Note: f-statistic is reported, with p-value in parenthesis
* denotes significance at 10% level
** denotes significance at 5% level
*** denotes significance at 1% level

TABLE 5. CLASSIFICATIONS OF FINANCIAL INSTITUTIONS BY PORTFOLIOS

AS COMPARED TO STANDARD INDUSTRIAL CLASSIFICATION CODE, RESULTS FROM 2-FACTOR MODEL

Portfolio	6021	6022	6035	6036	6099	6111	6141	6162	6199	6211	6282	Total
1	11	4	1	1	1	0	0	0	2	2	0	22
2	14	13	2	1	0	1	0	0	3	0	0	34
3	14	8	1	1	0	0	0	1	2	4	0	31
4	25	10	0	2	0	0	1	0	2	2	0	42
5	5	5	0	0	0	0	1	0	1	0	1	13
6	6	1	1	3	0	0	0	0	0	0	0	11
7	2	2	0	0	0	0	0	0	1	0	2	7
8	2	0	0	1	0	0	0	0	0	0	0	3
9	2	0	0	1	0	0	0	0	0	0	0	3
10	0	0	0	0	0	0	1	0	0	0	0	1
Total	81	43	5	10	1	1	3	1	11	8	3	167

Depository institutions
6021 Nationally charted commercial banks
6022 State chartered commercial banks
6035 Federally charted savings institutions
6036 State charted savings institutions
6099 Functions related to depository banking not elsewhere classified

Non-depository credit institutions
6111 Federal and federally sponsored credit agencies
6141 Personal credit institutions
6162 Mortgage bankers and loan correspondents

Security and commodity brokers, dealers, exchanges and services
6211 Security brokers, dealers, and flotation companies
6282 Investment advice

Others
6199 Financial services

Table 6. Composition of the Ten Portfolios

Portfolio 1	
Colorado Natl Bankshares	6021
First Interstate Bancorp	6021
Sterling Bancorp/NY	6021
First Commerce Corp	6021
Chase Manhattan Corp	6021
Manufacturers Hanover Corp	6021
Southeast Banking Corp	6021
Union Planters Corp	6021
U S Bancorp	6021
Valley National Corp Arizona	6021
Zions Bancorporation	6021
First Security Corp/DE	6022
Mark Twain Bancshares	6022
West One Bancorp	6022
Sumitomo Bank of California	6022
First Westn Finl Corp	6035
Western Savings & Loan Assoc	6036
Advance Ross Corp	6099
ITT Corp	6199
Acceptance Insurance Cos Inc	6199
Salomon Inc	6211
Integrated Resources Inc	6211
Portfolio 2	
Synovus Financial Cp	6021
Central Fidelity Banks Inc	6021
Corestates Financial Corp	6021
First Of America Bank Corp	6021
First Maryland Bancorp	6021
INB Financial Cp	6021
Fleet Financial Group Inc	6021
Wells Fargo & Co	6021
Manufacturers National Corp	6021
UJB Finl Corp	6021
Signet Banking Corp	6021
NBD Bancorp Inc	6021
Security Bancorp Inc/MI	6021
Southtrust Corp	6021
Associated Banc-Corp	6022
Banponce Corp	6022
Baybanks Inc	6022
Central Jersey Bancorp	6022
Dauphin Deposit Corp	6022
Equitable Bancorporation	6022
Fifth Third Bancorp	6022
First Hawaiian Inc	6022
Lincoln Financial Corp	6022
Merchants N Y Bancorp Inc	6022
Ramapo Finl Corp	6022
Santa Monica Bk Calif	6022
U S Trust Corp	6022
Golden West Financial Corp	6035
Ahmanson (H F) & Co	6035
Downey Savings & Loan Assc	6036
Federal Natl Mortgage Assn	6111
Acmat Corp	6199
Loews Corp	6199
Riverside Group Inc	6199
Portfolio 3	
Boatmens Bancshares Inc	6021
Brenton Bks Inc	6021
Community Natl Bancorp	6021
Deposit Guaranty Corp	6021
Florida Natl Banks Of Fla	6021
Norwest Corp	6021
Citicorp	6021
Chemical Banking Corp	6021
Mercantile Bancorporation	6021
Meridian Bancorp Inc	6021
First Chicago Corp	6021
Republic New York Corp	6021
Riggs Natl Corp Wash D C	6021
Sunwest Finl Services Inc	6021
Banks of Iowa	6022
Union Bank San Francisco	6022
Dominion Bankshares Corp	6022
Jefferson Bancorp Inc	6022
Bankers Trust New York Corp	6022
Old Stone Corp	6022
Trustcorp Inc	6022
Transworld Bancorp Calif	6022
Great Western Financial	6035
Mercury Savings & Loan Assc	6036
Lomas Financial Cp	6162
TransAmerica Corp	6199
Equitable of Iowa Cos	6199
Merrill Lynch & Co	6211
Paine Webber Group	6211
Realamerica Co	6211
Ziegler Co Inc	6211
Bank South Corp	6021
Citizens & Southern Corp-Ga	6021

Table 6. Composition of the Ten Portfolios

Portfolio 4	
Great Western Financial	6035
Golden West Financial Corp	6035
Ahmanson (H F) & Co	6035
Imperial Corp of America	6036
Financial Corp-Santa Barbara	6036
Downey Savings & Loan Assc	6036
Federal Natl Mortgage Assn	6111
City National Corp	6021
Commerce Bancshares Inc	6021
F & M Natl Corp	6021
First American Corp/TN	6021
Trustmark Corp	6021
First Commercial Corp	6021
First Florida Banks Inc	6021
Star Banc Corp	6021
First Tennessee Natl Corp	6021
Firstier Financial Inc	6021
Fourth Financial Corp	6021
Hibernia Corp -Cl A	6021
Huntington Bancshares	6021
Bank of Boston Corp	6021
First Fid Bancorporation	6021
Merchants National Corp	6021
Firstar Corp	6021
Michigan National Corp	6021
Midlantic Corp	6021
Security Pacific Corp	6021
Southern National Corp	6021
Crestar Financial Corp	6021
Valley Bancorporation/WI	6021
Ameritrust Corp	6022
Bancorp Hawaii Inc	6022
Chittenden Corp	6022
Morgan (J.P.) & Co	6022
Bank Of New York Co Inc	6022
First Pennsylvania Corp	6022
Northern Trust Corp	6022
Barnett Banks Inc	6022
Puget Sound Bancorp	6022
United Carolina Bancshares	6022
Landmark Land Co	6036
Miw Investors-Washington	6036
Beneficial Corp	6141
Sunamerica Inc	6199
Re Capital Corp	6199
Edwards (A.G.) Inc	6211
American Express	6211

Portfolio 5	
Compass Bancshares Inc	6021
Liberty National Bancorp/KY	6021
Marshall & Ilsley Corp	6021
Nationsbank Corp	6021
South Carolina Natl Corp	6021
CCB Financial Corp	6022
Comerica Inc	6022
First Virginia Banks Inc	6022
Mercantile Bankshares Corp	6022
Old Kent Financial Corp	6022
Household International Inc	6141
Midland Co	6199
Pioneer Group Inc	6282

Portfolio 6	
Cullen/Frost Bankers Inc	6021
Hawkeye Bancorporation	6021
Equimark Corp	6021
Continental Bank Corp	6021
BankAmerica Corp	6021
United Banks of Colorado	6021
Affiliated Bankshares Colo	6022
Olympus Cap Corp	6035
Imperial Corp of America	6036
Financial Corp-Santa Barbara	6036
Transcapital Financial Corp	6036

Portfolio 7	
National Comm Bancorp/TN	6021
Citizens Fst Bancorp Inc/NJ	6021
State Street Boston Corp	6022
Wilmington Trust Corp	6022
Leucadia National Corp	6199
Eaton Vance Corp	6282
Dreyfus Corp	6282

Portfolio 8	
Liberty Bancorp Inc OK	6021
Mcorp	6021
American Century Corp	6036

Portfolio 9	
American Bancorp/OH	6021
Bancoklahoma Corp	6021
Gibraltar Financial Corp	6036

Portfolio 10	
Cencor Inc	6141