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Interest Rate Risk and Thrift Capital

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ABSTRACT

Interest Rate Risk and Thrift Capital

By

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Accurate and meaningful measurement of interest rate risk (IRR) is of critical importance to depository institutions. Recently, Congress has included IRR in the risk evaluation of depository institutions for risk based capital standards. In foresight of this regulation, the Office of Thrift Supervision developed the Market Value Model (MVM) to measure IRR. This study conducts two tests using the MVM IRR. The first test compares the ability of various IRR proxies to predict thrift failure. Besides the MVM IRR measure, this study evaluates two other IRR proxies. In logit regressions including an IRR variable and other control variables, the first test finds each IRR variable significant in predicting failure. Including all three IRR variables shows several variables significant, suggesting the information they provide is additive and multiple measures may provide a superior evaluation of thrift interest rate and default risk. When an interactive product between capital and each IRR measure is included in the previous regressions, each interactive term shows firms with higher capital levels are less sensitive to IRR. Including interactive dummy variables shows, for high capital levels, IRR is positively correlated to thrift health.

The second test employs the various IRR proxies in predicting equity returns. First, this is done in two stages. The first stage uses the two index market model and tests whether depository institution stock prices are sensitive to interest rate changes. The

second stage tests whether the interest sensitivity of equity is dependent on the IRR proxy. Using two stages, the results for the second test are unsuccessful as thrift equity is found unaffected by interest rate changes. Second, the test is run in a single stage. These results show the interest rate index and the interactive term between IRR and the interest rate index insignificant. Possible explanations for insensitivity in both tests are time period and firm sample selection.

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All fall short of the glory of God. Rom. 3:23 (paraphrase)

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CHAPTER 1 - INTRODUCTION

Measurement of interest rate risk is of critical importance to depository institutions (DIs), as a result of their long-term mortgages and short-term deposits. During the early and mid 1980's, interest rates were high and volatile which created an unfavorable environment for thrifts. Consequently, many thrifts failed because of excessive interest rate risk. Lately, risk based capital standards have received significant attention. Interest rate risk (IRR) is now included in the risk evaluation of the firm and used to compute adjustments to capital standards. Historically, IRR measurements have been based on simple balance sheet ratios. Recently, due to more frequent thrift failure and emphasis on IRR based capital standards, new measurement techniques, in particular the Market Value Model, have been developed and employed. As of yet, these methods have not been examined for their comparative accuracy or informational disclosure. This study tests the ability of the Market Value Model to outperform simple balance sheet ratios in measuring interest rate risk and predicting changes in thrift capital.

Previous tests use simple balance sheet ratios to proxy for interest rate risk. The proxy, SHORT, is the difference between the amount of assets and liabilities maturing in one year, standardized by equity value. Flannery and James (1984) find SHORT correlated to the interest rate sensitivity of equity values. Barth et al. (1985), successfully use the ratio of interest sensitive funds to total liabilities (ISF) in failure prediction. Each of these measures has been used successfully in various studies, but none account sufficiently for the unique characteristics of a thrift's asset and liability portfolio.

Regulators of banks and thrifts, realizing the potentially severe consequences of IRR, have developed more comprehensive risk measures. These measures not only implement a very detailed computation of the maturity and coupon of portfolio securities, but also analyze any option characteristics of these securities, such as prepayments. The Office of Thrift Supervision (OTS) developed the Market Value Model (MVM) especially for the purposes of measuring interest rate risk and determining risk based capital standards. The MVM measures IRR as the change in the market value of portfolio equity (MVPE) resulting from changes in interest rates. For regulatory purposes, the MVM uses 200 basis point parallel shifts upward and downward resulting in two IRR measures, referred to here as Uchg and Dchg, respectively. In conjunction with an increasingly comprehensive interest rate risk proxy, the OTS has required significant increases in the disclosure of financial information. Section H has been included in the Thrift Financial Report since 1985 and separates balance sheet accounts and account yields into seven maturity or repricing "buckets".

This research uses two models to test the effect of IRR on thrift capital and thrift equity returns. Bovenzi et al. (1983) and Barth et al. (1985) use the first model that shows interest rate risk to be a significant predictor of financial institution failure. Theoretically, failure is when market net worth is equal to zero and therefore indicates capital depletion. In practice, failure depends on the book value of net worth as well as other factors. The failure prediction methodology shows which firm characteristics are related to firm failure and therefore which characteristics are associated with the depletion of net worth or capital value. Comparing various IRR measures in a failure prediction model will show which measure is a better indicator of probable failure. Consequently, this comparison will show which IRR variable(s) would be the most useful with risk based capital standards.

The second model is a two index market model that measures the effect on thrift stock price from a changing market and interest rate index. Several tests (Lynge and Zumwalt (1980), Sweeney and Warga (1986), and others) have shown a relationship between the returns of financial institutions' common stock and interest rate movements. Kane and Unal (1988), Kwan (1991) and Yourougou (1990) have extended this research by showing that the sensitivity of thrift capital to interest rate changes is not constant. Evidence that the interest sensitivity of stock price is related to maturity mismatch is found by Flannery and James (1984) and Scott (1986). Showing that equity value is related to maturity mismatch confirms the theory that thrift equity is interest rate sensitive. The IRR proxy that most effectively predicts stock price sensitivity should be the best measure of IRR and thrift default risk. Therefore this proxy should be the best proxy for risk based capital standards. Stock price movements may be a better measure of changing capital values than failure because common stock prices measure market values, while failure partly depends upon book values. Further, stock price movement is measured more frequently and thus should be a more powerful indicator than failure.

This study proceeds in the following order. The next chapter reviews the related literature. This review begins with a discussion of the literature analyzing the interest sensitivity of financial institution's common stock. This includes a review of the relationship between equity values and an interest rate index, the relationship between the interest index and a maturity mismatch proxy, and the stationarity of the significance of the interest rate index. The review continues by recalling the literature on financial institution failure, with attention given to accounting versus market predictive variables and problem status as the dependent variable. Further, several studies showing the significance of interest rate risk as a predictor of failure will be reviewed. The third chapter describes the Market Value Model as a measure of interest rate risk. This chapter details the discount, interest rate forecasting, and present value methods used in the model. The research methodology and data for the failure prediction model are explained in the fourth chapter. Chapter five presents the methodology and results for the two-index model. Concluding remarks are in Chapter six.

CHAPTER 2 - REVIEW OF RELATED LITERATURE

2.1 Literature on Interest Sensitivity of Financial Institution Equity

Risk based capital regulation presumes a relationship between interest rate risk and capital risk. Empirical tests have shown stock returns are sensitive to changes in interest rates, particularly stocks in the financial and utility industries. This section continues with a review of the theoretical explanations and empirical studies of this phenomenon.

2.1.1 Theoretical Literature

The most prevalent of the theoretical explanations is the nominal contracting hypothesis.[1] This hypothesis divides firm assets into categories of real and nominal. Nominal assets are those whose cash flows are defined in nominal terms and do not adjust to changes in inflation. Cash flows of real assets do adjust to inflationary changes. This hypothesis maintains that common stock returns of firms holding nominal assets will be affected by unanticipated inflation and unanticipated changes in expected inflation. Fama (1975,1976), Fama & Gibbons (1982), and Nelson & Schwert (1977) suggest movement in the term structure of interest rates results primarily from changes in inflationary expectations. Therefore the nominal contracting hypothesis implies a relationship between stock returns and interest rate changes. Stockholders of firms with fewer nominal assets than nominal liabilities should benefit from unexpected increases in inflation.

Merton (1973) and Long (1974) imply that if a risk averse investor is choosing between two portfolios giving the same distribution of future wealth but which have different covariances with interest rates, the investor will select the portfolio that gives

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[1] French et al. (1983) introduce the nominal contracting hypothesis.

them a better hedge against unfavorable shifts in interest rates. Security prices will differ according to their interest rate sensitivity. Merton further shows that securities that are claims on real assets, such as industrial firm stocks, are less sensitive to unexpected changes in nominal interest rates than those which are claims on monetary assets, such as financial intermediary common stocks.

For regulated industries, a regulatory lag implies utilities will face a delay between the time their costs rise and the time they are allowed to raise their output price. This will reduce the stock's price. According to Sweeney and Warga (1986), the equivalent of this for depository institutions was eliminated with the Garn-St. Germain Act, when interest rate ceilings were removed.

Logue and Sweeney (1981) provide cross-country evidence that increases in inflation bring greater real economic instability. They argue that this is costly and reduces the real return on capital. Samuelson (1945) suggests interest rate sensitivity depends on the mismatch of balance sheet cash flows. In spite of the logical justifications for each of these theories, the nominal contracting hypothesis is most frequently cited as the explanation for the interest sensitivity of financial institutions' stock returns.

2.1.2 Empirical Literature

The empirical literature on the sensitivity of the stock price of financial institutions to changes in interest rates is well developed. Stone (1974) suggests and implements the use of a two index model to value the common stock of financial institutions. The two index model is as follows:

$$R_{jt} = \beta_{0j} + \beta_{mj}R_{mt} + \beta_{Ij}R_{It} + \varepsilon_{jt}, \qquad (5.1)$$

where,

R_{jt}- the holding period return to the j^{th} stock over the month ending at time t,

R_{mt}- the holding period return on an equity index over the month ending at time t,

R_{It}- the holding period return on a debt index over the month ending at time t, and

ε_{jt}- error term.

Chance and Lane (1980) use the two index model to show financial institutions' equity value unaffected by interest rates. Lynge and Zumwalt (1980) show both long and short interest rates are significant in predicting stock price separately in a two index model and together in a three index model. Giliberto (1985) suggests the significance test used by Lynge and Zumwalt (1980) and others was incorrect. Only Chance and Lane (1980) use the correct test and find interest rates insignificant. Sweeney and Warga (1986), testing the model using a variety of industries, find financial institutions and utilities are most sensitive to changes in interest rates.

The following studies offer an explanation for the variability in size and significance of the interest sensitivity of an institution's equity. Kane and Unal (1988) show that interest sensitivity varies over time with different regimes and that the time varying regimes depend on the specific type of institution. Kwan (1991) and Yourougou (1990) support the conclusion of time varying interest sensitivity. Kane and Unal (1990) provide a framework for explaining time variability by showing that the on and off-balance sheet values of institutions vary oppositely with interest rates. Each institution's variability is a weighted average of the two value sensitivities. Song (1994) uses an ARCH model to show significant sensitivity of financial institutions and compares results with previous time varying results. Flannery and James (1984) and Tarhan (1984) show interest rates significant in predicting equity returns for institutions and suggest the interest rate coefficient is a function of portfolio maturity mismatch. Only Flannery and James show the maturity mismatch correlated to interest rate sensitivity. Scott (1986) supports the conclusion of Flannery and James by showing that portfolios of different types of institutions with increasing maturity mismatch have an increasing sensitivity to interest rates. Following is a detailed review of the literature beginning with the interest sensitivity of common stocks, proceeding with the time variability of the sensitivity coefficient, and finishing with the correlation between sensitivity and maturity mismatch.

Lynge and Zumwalt (1980) empirically test the interest rate sensitivity of commercial bank common stock returns. They accomplish this by estimating several multi-index models containing debt return indices. Two separate debt return measures are used: a long-term bond index and a short-term (one month) debt index. Each measure is used separately in a two index model, and then the two measures are used simultaneously in a three index model. Because of the construction of these debt indices, they will behave differently for a given change in long or short-term interest rates. Since short returns are dominated by the "interest" return on Treasury bills (at the end of each month only a few days remain until maturity, so the price is not very different from the face value), this index is highly positively correlated with the Treasury bill rates and is always positive. However, the long-term bond index tends to be dominated by price changes (because of the long period remaining to maturity at the end of each month) and often takes on negative values. Thus, long index returns are negatively correlated with long-term interest rates. Therefore, controlling for a market influence, if stock prices decline (rise) when interest rates rise (decline), we would expect a negative coefficient for a short return index and a positive coefficient for a long return index.

Lynge and Zumwalt estimate parameters for the 1969-1972 period to provide a basis of comparison with the results of Lloyd and Shick (1977). The estimated equity betas in the single index model for this period are all positive and 54 of 57 are significant at the 5% level. These beta values range from .358 to 1.265 and have an average value of .810. These results differ substantially from the equity betas calculated by Lloyd and Shick (1977) and appear to be more reasonable values for commercial bank equity betas; they also compare favorably with those reported by Value Line. The models were also estimated for the 1969-1975 period. The additional three years provide a highly volatile interest rate environment that may highlight the interest sensitivity of these stock returns. Lynge and Zumwalt find bank stocks exhibit a higher degree of interest rate sensitivity during the 1969-1975 period than during the 1969-1972 period. This is demonstrated by the substantial number of firms having significant coefficients for the debt indices during the longer sample period. These results lend support to the contention of Stone (1974) that a second factor reflecting interest rate movements will improve the performance of the market model, at least for commercial bank security returns. Lynge and Zumwalt report results even more supportive of the two index model than those reported by Lloyd and Shick (1977).

Chance and Lane (1980) use monthly prices for the years 1972-1976 and conclude that extra market interest rate sensitivity is not present in the common stocks of financial institutions. This conclusion holds with respect to short, intermediate, and long-term interest rates, a conclusion contrary to that of previous findings.

Giliberto (1985) reviews several studies using a multi-factor model to examine the interest rate sensitivity of a financial intermediary's common stock. These reviewed studies use an alternate specification of the model in an attempt to estimate each factor's influence. Giliberto's note shows that the re-specification results in biased estimators. Hypothesis tests are flawed by failure to acknowledge the bias; this casts doubt upon the reported findings. The published evidence is contradictory. Lynge and Zumwalt (1977) and Lloyd and Schick (1977) report support for an interest-rate factor; Chance and Lane (1980) did not find a significant effect. However, only the latter used an unbiased estimator to examine the interest-rate sensitivity. Although all studies used the same basic model, each study introduced a misspecification that biases some, but not all, of the coefficient estimates. According to Giliberto, there is no reliable evidence that financial intermediaries' stock prices are sensitive to interest rate changes.

Sweeney and Warga (1986) examine whether firms are required to pay investors ex ante for bearing this risk of interest rate changes. The paper uses full information maximum likelihood (FIML) estimation on groups of twenty-five individual firms, with both cross-equation constraints and within equation nonlinear constraints on the parameters as mandated by the APT model. Equally weighted portfolios were formed based on the two digit SIC. Utilities were broken down into three portfolios and they had the largest interest rate sensitivity. The only other portfolio with a significant interest index was composed of banking, finance, and real estate firms.

The following research provides additional evidence indicating financial institution stock price returns are sensitive to an interest rate index. Then these studies extend the literature by including tests of the significance of firm maturity mismatch in predicting interest rate sensitivity. Maturity mismatch is the difference between average asset maturity and average liability maturity and is frequently measured as the short-term assets minus the short-term liabilities standardized by firm value.

Tarhan (1984) measures the unexpected movements in interest rates in two ways. In the first and more novel approach, interest rate movement is proxied by money supply announcements. There is evidence pointing out that money announcement surprises cause unanticipated movements in interest rates. The second approach uses unanticipated interest rates based on an ARIMA, autoregressive integrated moving average, model, similar to the interest rate movement used in other studies.

Every quarter, the banks in Tarhan's study are ranked according to the size of their gap (maturity mismatch) positions. On the basis of these rankings, three equally weighted portfolios are formed. The reaction of these portfolios to money supply announcements is investigated first. Three different tests are performed to analyze this issue. In the first test, the portfolio returns on the days following the money supply announcements are compared to see whether or not the response is related to the gap positions. The second test compares the returns of the portfolios using a seemingly unrelated regression technique. In the third test, the relation between the reaction of bank stocks and gap positions of banks is investigated using a non-parametric approach. All of these tests are then repeated for the case where the residuals, obtained from an ARIMA model of daily interest rates, are used as the proxy variable for unanticipated interest rates.

All the tests conducted in Tarhan's study point out that there is no relationship between interest sensitivity and the maturity structure of bank balance sheets. Tarhan suggests several possible explanations for this result. For example, factors such as how a given change in interest rates affects the quality (probability of default) of bank assets may be a more important consideration to investors than the actual interest rate movement. Another possibility is that through the use of interest rate futures and interest rate swaps, banks may be well hedged against interest rate exposure. Finally, it can be argued that the gap measure employed in this study is an inadequate proxy of maturity mismatch.

Tarhan shows that bank stock returns are affected by unanticipated changes in interest rates in a statistically significant manner. What is not supported by the results of Tarhan's paper is the contention that the bank stock reaction to unanticipated interest rates is related to the gap positions of banks. This latter conclusion is in agreement with French, Ruback and Schwert (1983).

Flannery and James (1984) test the effect of interest rate changes on the common stock returns of financial institutions. In the absence of a common or accepted motivation, Flannery and James are the first to suggest the nominal contracting hypothesis. Testing the nominal contracting hypothesis requires detailed balance sheet information, such as the information on the maturity structure of assets and liabilities provided by DI's. They use weekly data from 67 commercial banks from 1976 through 1981. They regress stock price returns onto a market index and an interest rate index to determine if banks have a significant interest rate sensitivity. The nominal contracting theory also suggests that common stock sensitivity to interest rate changes is dependent on the firms average maturity of assets and liabilities. To proxy for average maturity they subtract short-term liabilities from short-term assets and divide the result by equity value (SHORT). Regressing the coefficient of the interest rate index onto SHORT, they test for the significance of contract maturity. Their results confirm that commercial bank stock returns are very sensitive to interest rate changes regardless of the interest rate index employed. When regressing the coefficient of the interest rate index onto the maturity proxy, both the intercept and the coefficient of the maturity proxy are found to be significant. The significant maturity proxy coefficient implies that firm interest sensitivity is responsive to contract maturities. The significant intercept suggests that firms whose short-term assets are equal to their short-term liabilities are still sensitive to interest rate changes. An alternate explanation of the significant intercept is the relationship between maturity mismatch and interest rate sensitivity may be nonlinear.

Flannery and James do a final comparison between the interest sensitivity for commercial banks and interest sensitivity for savings and loans. Savings and loans have a greater maturity mismatch and should be more sensitive to changing interest rates. This is confirmed and S&L sensitivity is estimated to be more than twice the sensitivity of commercial banks. The results from both of their tests support the nominal contracting theory.

Scott and Peterson (1986) investigate the extent to which portfolios of commercial banks, savings and loan associations, and life insurance companies' equity values are affected by unexpected changes in interest rates. Their paper analyzes the effect of monthly changes in T-bond yields on the stock market returns of financial institutions for the years 1977 through 1984. The results of the equations show that unexpected T-bond yield changes have a significant effect on financial institutions' returns. Thus, these results reinforce those of Flannery and James (1984) and others who find the interest rate changes have a significant effect on stock market valuations of financial institutions' shares. Scott and Peterson show further that portfolios of different types of institutions with increasing maturity mismatch have an increasing sensitivity to interest rates.

The remaining papers examine whether the risk sensitivities of financial firms are stationary. These papers provide possible explanations for the variable magnitude and significance of the interest rate index in predicting stock returns.

Kane and Unal (1988) find that the riskiness of bank and savings and loan stocks declined in the late 1970's but rose again later in the 1975-1985 period. They employ the Goldfeld-Quandt search routine as a way of developing policy analysis or event study benchmark models that can incorporate the effects of relevant movements in unspecified omitted variables. A switching-regression method provides a flexible way to identify changes in the systematic and unsystematic risks of asset portfolios. The strength of the technique is that the number of effective regimes, the parameter values in each regime, the switch dates at which one regime supersedes another, and the gradualness of each regime switch can all be estimated simultaneously.

Their results show savings and loans (S&Ls) experience significant shifts in market and unsystematic risk in early 1976, developing a significantly negative market beta and a greatly enhanced interest sensitivity. However, S&Ls show an abrupt second shift in 4/77, one combining increases in unsystematic risk and market beta with reduced interest sensitivity. In contrast to the 1979 shift for bank groups, the return-generating process for their small sample of S&Ls shows no switch during the 1979-1980 era. S&Ls undergo their third shift in late 1981, with market and unsystematic risk doubling and interest sensitivity declining to insignificance. In the late-1983 shift, market risk declines and interest sensitivity rises (both significantly), while the fall in unsystematic risk fails to achieve statistical significance. With only eight extremely large S&Ls in their sample (and most of these headquartered in California), it is doubtful that the regression shifts they observe are representative of the S&L industry as a whole. Interest rate sensitivity varies over a far wider range of values for S&Ls than for banks. Moreover, three out of the four shifts in S&L interest rate sensitivity prove significant. During the 9/81-9/83 regime, although interest rates were highly volatile, S&L stocks show near-zero interest sensitivity. This may trace not only to a higher incidence of adjustable-rate mortgages and to mortgage prepayments in the last part of this era but also to the extent of hidden economic insolvency at sample S&Ls. Deep insolvencies could have forced the Federal Savings and Loan Insurance Corporation (FSLIC) to absorb the bulk of interest induced profits and losses on short funded positions in long assets during this particularly troubled era. FSLIC's own growing economic insolvency and decreased staffing reduced the threat of formal failure and allowed firms to continue in insolvency.

Kane and Unal conclude that their sample of deposit institution stocks became riskier investments in the wake of the many regulatory relaxations made in the 1980's. They further suggest the information events of 1979 and 1982 substantially altered return-generating processes for deposit institutions' stock. Bank equity returns prove interest sensitive primarily during the 1979-1982 era, but S&L equity returns prove interest sensitive during the bulk of the observation period.

Yourougou (1990) examines interest rate risk and the pricing of depository financial intermediary common stock. Like Sweeney and Warga (1986), Yourougou (1990) uses firms from all industries and applies an APT model to determine interest sensitivity. Yourougou examines the impact of interest rate risk on security prices in periods of relative interest rate stability (pre-October 1979) and during periods of great volatility of interest rates (post-October 1979). A sample of 219 weekly returns was obtained for each of 83 banks, 32 S&L associations, and 100 industrial firms.

Yourougou's results from the post-October 1979 period of more volatile interest rates show interest rate risk had a significant impact on common stock prices for financial intermediaries, but the industrial firms have been shown to have little or no interest rate sensitivity. In the pre-October 1979 period, when interest rates were stable and the interest-rate sensitivities of common stock were relatively low for most firms, the interest rate risk appeared to have had no effect on stock prices. Their evidence further indicates that the inability to detect such a pricing effect for the sample of industrial firms and financial institutions in the pre-October 1979 period was due to the low interest-rate sensitivity, rather than the inadequate volatility of interest rates or the markets' failure to price interest-rate risk.

Kwan (1991) reexamines interest rate sensitivity of commercial bank stock returns using a random coefficient model. Flannery and James (1984) and Kane and Unal (1988) suggest that the interest rate beta in the two index model appears to be nonstationary. Bank stock interest rate sensitivity is first modeled as a function of a bank's maturity profile. This relationship then substitutes into the traditional two index model. This method is unique in that it allows a time varying beta. Kwan's findings suggest that commercial bank stock returns are related to unanticipated interest rate changes.

In support of the hypothesis that an increase in the duration of net nominal assets corresponds to an increase in the interest sensitivity of bank stock returns, Kwan finds the coefficient of a maturity proxy positive and significant. The effect of unanticipated changes in short-term interest rates on bank stock returns, after accounting for the maturity proxy, is also found to be significant for a number of banks. When the long-term rate is used in constructing the interest rate index, the maturity proxy ceases to have explanatory power for interest rate sensitivity. However, bank stock returns are still sensitive to changes in the long-term interest rate, which is evidenced by a large number of significantly positive intercept terms. The intercept now captures the interest rate sensitivity caused by both the duration mismatch and the factors not related to balance sheet composition. A possible explanation for the above phenomenon is the maturity proxy is a noisy measure in determining duration mismatch between long term assets and liabilities. Second, changes in the term structure of interest rates are not always a parallel shift.

Kane and Unal (1990) acknowledge the accounting representation of a firm's net worth diverges from its economic value, by an amount they call hidden capital. Two sources of hidden capital exist: accountants' misvaluations of portfolio positions that accounting principles designate as on balance sheet items and the systematic neglect of off balance sheet sources of value. Their paper develops a model for estimating both types of hidden capital. The model makes direct use of accounting information on the bookable positions of a firm and separates bookable from unbookable sources of value. They use regression analysis to partition the total market value of a firm's stock into two components: recorded capital reserves and unrecorded net worth. Hidden capital is then allocated between values that are unbooked but bookable through asset turnover or write-downs on a historical cost balance sheet under Generally Accepted Accounting Principles (GAAP) and values which GAAP currently designates as an unbookable off balance sheet item.

Kane and Unal estimate the net unbooked value of on balance sheet positions by estimating an intermediate variation ratio. This variable expresses the ratio of the market value to the book value of the collected components of a firm's bookable equity. Applying the valuation ratio to the value of accounting or book net worth assigns a market value to bookable assets and liabilities. Subtracting this estimate from market capitalization assigns a value to off balance sheet items. This statistically appraised value of unbookable equity expresses the net value of unbookable assets and liabilities. They call this regression equation, the Statistical Market Value Accounting Model, SMVAM. Bank stock shares have shown weak and sporadic sensitivities to interest rates rather than strong and consistent ones, even though the value of a bank's individual asset and liability positions is inherently interest sensitive. Because GAAP gives bank managers options to realize unbooked gains and losses as "nonrecurring items" and authorities penalize low book value, individual banks have an incentive to sell assets with unrealized gains when the book value of their capital appears inadequate. In contrast, no reason exists to expect the valuation index to be a function of size, and estimated rank orderings of the valuation index against bank size class do vary over time. The model's coefficients describe the de facto deceptiveness of GAAP. Unless both unbookable net worth equals zero and the valuation index equals one, the accounting or book value of a bank's capital represents a biased estimate of the market value of stockholder equity. As an example, off balance sheet liabilities at the five largest U.S. banking firms totaled $1.16 trillion at year end 1986. This value is more than twice the $546 billion book value of these banks' assets (Forde 1987).

In principle, each bank has a different unbooked equity and valuation index at each date. To estimate the model, it is necessary to restrict parameter variation either across time or across banks. To consider the full effect of the mutability of the 1975-1985 environment, they restrict SMVAM parameters across banks rather than across time. In applying the model cross sectionally, they restrict the valuation ratio applicable to each bank at a specific time to have the same valuation index across each bank class. To lessen the information loss from this restriction, it is necessary to focus on relatively homogenous subsamples of banks. The estimates for unbookable capital and the valuation ratio are then separately regressed in the two index model. This shows the interest sensitivity of both booked and unbooked assets and suggests that firm sensitivity is a weighted average of the sensitivities of the two parts. Further, it provides an explanation for time varying interest sensitivity.

When this model is applied to a sample of bank stocks, the interest and market sensitivities of bookable and unbookable values are often different in sign. In particular, increases in the value and sensitivity of hidden capital at the nation's 25 largest banks during the interest-rate spike of 1978-1982 cushioned a sharp decline in the valuation ratio for their net bookable assets. This is consistent with the hypothesis that during this period, increases in unbookable value resulted from Federal Deposit Insurance Corporation (FDIC) guarantees and enhancements in franchise values fed by technological change and relaxations of regulatory restrictions. Although they apply the model only to bank stock shares, in principle it could be used for any corporation. By permitting regime changes in the valuation models that reset market values each quarter, their methods provide new insight into changes in: (1) the market and interest sensitivity of a corporation's stock and (2) the impact of off balance sheet positions on a firm's stock price.

Song (1994) applies autoregressive conditional heteroskedasticity (ARCH) modeling to the study of deposit institution stock returns. The questions Song investigates are whether and to what extent the market and interest rate risks of depository institutions have been changed in the 1980's. The two-factor ARCH model allows Song to identify the dynamic pattern of the market and interest rate risks. Finally, comparing the two-factor ARCH model and the switching regression model with the constant-beta model suggests that the two factor ARCH model provides a better measure for the average trend in the betas for the deposit institution stock returns.

Song shows the interest rate risk for money center banks and savings and loans is positive; a positive value of interest rate risk means that the firm's market value declines when interest rates rise. One surprising finding is that there was no big difference in the interest rate risks between banks and S&Ls. The S&Ls in this sample are all large institutions and may be as efficient as large banks in hedging interest rate volatility.

Kane & Unal (1988) suggest bank stock returns are interest sensitive primarily during the 1979-1982 era, but S&L stock returns are interest sensitive during the entire period of 1975-1985. Song finds interest rate risk for all three types of depository institutions showing only small increases at the end of 1979. This is consistent with the evidence found by Aharony, Saunders, and Swary (1986) that there was no significant change in market or interest rate risk (IRR) for banks and S&Ls around October 1979. At the end of 1982, all three types of depository institutions show a small increase in IRR, suggesting that deregulation allowed the institutions to take more unbalanced positions.

Several events during 1982 are of significance. The repel of Regulation Q by the Depository Institutions Deregulation Committee, established under the DIDMCA, occurred in December 1982. In August, Mexico declared a moratorium on its foreign debt. In November, Congress passed the Garn St. Germain Act which among other purposes, authorized MMDA, Money Market Deposit Accounts, and SuperNow accounts. In 1982, the number of failed and problem institutions increased sharply. Kane and Unal suggest the combined effect of these events seemed to increase the risk exposure of depository institutions.

Song's results suggest that both bank and S&L stock returns have a slightly higher and more volatile interest rate beta since 1982 then during the 1979-1982 period when the Fed altered its monetary policy. Significant changes in the risk exposure of depository institutions suggest the importance of modeling the time varying betas in the market model for deposit institution stock returns especially in the 1980's, because of dramatic changes in banking regulations and the economic environment. In conclusion, this study casts doubt on the results obtained from conventional event studies that assume constant betas in the market model.

2.2 Literature on the Failure of Financial Institutions

Another way to test the relationship between interest rate risk and the common stock price of financial institutions is through a failure prediction model. Tests of this relationship in failure prediction models regress thrift failure against interest rate risk as well as other relevant variables.

Prediction models of thrift failure have three applications. First, the model can be used as an early warning system, a system that identifies operating thrifts with similar financial characteristics as failed thrifts. These operating thrifts are then considered for regulatory examination. A second use is in relation to federal deposit insurance. The variables and coefficient values relevant to failure, could be used in adjusting premiums for deposit insurance. Similarly, a third application relates to risk based capital standards.

Risk based capital regulation increases required capital levels for firms with more risk. Firm characteristics positively associated with the probability of failure could be used to adjust required capital levels.

I first review tests that predict failure with either call report or examination data. The review continues with models, predominantly Sinkey (1975, 1978), that attempt to predict the Federal Deposit Insurance Corporation's problem bank list. Finally, studies that employ market prices along with call reports and /or examination data are reviewed. The literature is summarized in Table 1.

2.2.1 Failure Prediction with Accounting Data

Martin (1977) uses bank call report data to determine bank failure. Martin compares discriminant analysis with a logit model and suggests their relative merits depend on the intended use of the results. If classification is the goal, the models' accuracy is similar. If the determination of a risk premium for deposit insurance is the goal, then the performance of the logit model is slightly superior.

Collins (1982) predicts failure using credit union data. Collins compares the assumptions and predictive abilities of several statistical models. The assumptions underlying the linear model and multiple discriminant analysis are not consistent with the bankruptcy forecasting problem, but their performance is surprisingly good. The logit model, which a priori appears to match the requirements of the bankruptcy problem well, performs only slightly better than the previous models. The logit model provides a modest increase in the overall classification accuracy, and substantially reduces type I error. Since the purpose of most models is identifying failure, this is an important result.

Bovenzi, Marino, and McFadden (1983) review the present body of literature, then add a comparison of bank call report data and examination data. Examination data is found to improve the accuracy of classification, but the improvement diminishes as the time to failure increases. Examination data alone is found, at best, to be as good as call report ratios. A review of sampling techniques shows that for unweighted nonrepresentative samples the constant term of the model is biased in a direction that overestimates failure probabilities. The t-statistics of the estimates are also problematic and may distort the significance of the relation of the financial ratios to failure.

Bovenzi et al. (1983) use the difference between market rate assets and market rate liabilities divided by equity capital as an interest rate sensitivity variable. This variable improved the classification of the model, but was not as informative as the efficiency or credit risk variables. This may indicate that interest rate risk is not the most serious problem facing banks or it may indicate this interest rate sensitivity variable is not an accurate indicator of a bank's interest rate risk.

Korobow and Stuhr (1983) use bank call report data to predict failure but distinguish between different peer groups. In the group of banks with over $300 million in assets, 12 of the 13 marginal or weak banks had at least one foreign office. The inferior performance of the multinational banks tends to increase with asset size.

Richardson and Davidson (1983) predict bankruptcy in firms listed on the American Stock Exchange. The classification ability of linear discriminant analysis is found to be sensitive to three non-linear transformations of normality: the log normal, the logit normal, and the inverse hyperbolic sine normal. The classification ability is also affected by deviations from normality in the accounting data. These deviations cause small, but statistically significant differences in classification.

Barth, Brumbaugh, Sauerhaft, and Wang (1985) use a logit model to predict the failure of S&Ls. They use data from the Thrift Financial Report beginning in 1982 and continuing through mid-1984 and they test the significance of twelve independent variables from categories similar to other tests. They find most of their variables significant; the most relevant to this study is the significance of their proxy for interest rate risk.

Barth et al. (1985) use three different variables for measuring interest rate risk: interest sensitive funds, jumbo certificates of deposit (CDs), and cost of advances.[2] In analysis of variance tests between failed and non-failed thrifts, all three variables were significant at the five percent level, at all three time periods: failure, six months prior to failure, and twelve months prior to failure. In the multinomial regressions, the most explanatory model included interest rate risk only six months prior to failure. The most predictive of the three interest rate variables was interest sensitive funds.

Rose and Kolari (1985) use univariate and multiple discriminant analysis to predict failure with bank call report data. Tests using linear and quadratic discriminant analysis show the predictive accuracy of linear models superior to that of quadratic models. Ratio analysis suggests the failure process for commercial banks is generally marked by liquidity

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[2] Interest sensitive funds = Interest-sensitive funds (savings accounts earning interest above regulated rate plus, Federal Home Loan Banks advances due in one year or less, and other borrowed money due in one year or less)/Total funds (non-interest-earning demand and NOW accounts plus savings accounts earning interest below regular rate, and FHLB advances and other borrowed money)
Jumbo CD/Total liabilities
Cost of advances/Total liabilities

problems on the asset side of the balance sheet and increasing risk exposure in both loans and interest sensitive liabilities. Summarizing their results, troubled banks experience a squeeze on their profit margins due to the interaction of expense control difficulties, including loan losses, and rising interest costs associated with the acquisition of deposits.

Pantalone and Platt (1987a) use Thrift Financial Reports from Boston area thrifts to predict failure with linear discriminant analysis. Testing both linear and quadratic models, they conclude the linear model had better overall classification results. They find broker originated savings are positively correlated to thrift failure.

In another study, Pantalone and Platt (1987b) predict failure using a logit model with bank call reports. Healthy banks are found to have higher net income and equity ratios and relatively lower amounts of loans, particularly commercial and industrial loans. State economic variables are found insignificant in predicting a bank's state of health or failure in every model.

Cole (1993) compares the determinants of failure prediction to the determinants of closure prediction. There is almost complete overlap in significant variables between the two models, but the weights of these variables are much different for the two tests. The variables are categorized into operating and agency risk. The agency risk variables suggest the existence of owner, manager, and regulator agency conflicts. Further, the evidence from these tests indicate regulator forbearance was a greater problem in the later 1980's than in the earlier 1980's.

Thomson (1992) uses a two-step logit to predict closure. Variables correlated to failure include loans to insiders, a dummy for bank holding companies, and a dummy for unit branching states.

2.2.2 Loss Prediction with Accounting Data

Barth, Bartholomew, and Bradley (1990) provide a detailed examination of resolution costs of thrift institutions. They show that the model that most accurately predicts costs varies from the early and mid 1980's to the late 1980's. During the 1985-1988 period, their model shows discount rate, off-book items, non-performing assets, and core deposits are highly significant with the expected sign.

James (1991) predicts the losses realized in bank failures during the 1985-1988 period. He finds losses average 30% of bank assets. In a weighted least squares regression, seven different asset variables, book value of equity, and core deposits are significant in predicting realized bank losses.

2.2.3 Problem Status Prediction with Accounting Data

Other tests have attempted to use problem status as the dependent variable. Sinkey (1975) predicts problem status with a quadratic discriminant analysis model using bank call report data. Using a chi-square test, the mean vector of the problem banks was found to be significantly different from that of healthy banks, but the two distributions substantially overlap. Sinkey (1978) uses bank call report and examination data with discriminant analysis to predict problem status. The net capital ratio, a capital ratio adjusted for substandard loans, is the most significant variable and the most important classification discriminator. Examination data failed to add to the classification ability of the net capital ratio. Classifying large commercial banks by their net capital ratio produced a zero type I error.

Altman (1977) tests the problem status prediction ability of quadratic discriminant analysis on savings and loan call report data. The dependent variable has three possible states: no problem, temporary problem, and serious problem. Two measurements of management efficiency, net operating income / gross operating income and its associated two-period trend, are the most important indicators of problem status.

West (1985) employs a combination of factor analysis and logit to predict problem status in banks. Independent variables or factors are from call report and examination data. They find using factor scores as inputs in a multivariate logit estimation holds promise as an early warning system. The results of this test are robust to different geographic areas.

2.2.4 Failure Prediction with Market Data

According to the efficient market hypothesis, stock prices should incorporate all public information, including public accounting information. If this is the case, any abnormal negative return in the bank or thrift stock price may indicate financial trouble. Pettway and Sinkey (1980) use bank call report and market data to predict failure. Call report data show fewer investments and lower efficiency characterizes failed banks. The accounting information in a multiple discriminant analysis model detects all the failed banks in the sample, a type I error of 0. In all but one case the market filter detected the failed bank before the examination that led to problem status. The accounting filter generally led the market filter in predicting failure, but had a higher type II error.

Pettway (1980) predicts failure using market information on banks with a modified Fama, Fisher, Jensen, and Roll (1969) approach. Negative stock returns are found as early as 38 weeks before the exam that led to problem list status and as early as two years before failure.

Schick and Sherman (1980) use the Fama, Fisher, Jensen, and Roll (1969) method with examination and market data to detect decreases in stock price. Evidence clearly indicates that changes in condition are reflected in stock price. On average, detectable market decline predates the examination that led to problem status by an average of nine months.

To summarize, the benchmark statistical model for failure prediction is a logit. The independent variables most frequently found correlated to failure and problem status are related to the following categories: capital level, asset quality, management efficiency, earnings ability, and liquidity (CAMEL). The most notable exception to this is an interest rate risk variable that was found to be significant in some studies, but only at marginal levels, possibly because these measures were inaccurate proxies.

CHAPTER 3 - THE MARKET VALUE MODEL

Interest rate volatility has been a threat to savings and loan capital since the industry was created. Measuring the portfolio interest rate risk of a savings and loan (S&L) is problematic due to the diversity of securities in the portfolio and the data necessary to compute security specific interest rate risk (IRR). Ignoring these diversity and data problems, numerous tests of interest rate sensitivity use a simple gap measure. Information on securities repricing in more and less than a year is available and creates a one year gap bucket. A gap bucket is the difference in dollar amount between the assets repricing within one year and liabilities repricing within one year.

Continuing concern by the regulatory bodies of financial institutions about interest rate risk has led both the Office of Thrift Supervision (OTS) and the Federal Reserve Bank (FRB) to develop a more accurate proxy for this risk. The OTS Market Value Model (MVM) measures IRR as the percentage change in the market value of institution portfolio equity (MVPE) as a result of a hypothetical interest rate shock. To calculate the MVM, first compute the present value of future cash flows for each asset and liability. Second, determine the MVPE by subtracting the present value of all the liabilities from the present value of all the assets. Third, adjust the discount rate with an interest rate shock. Then, use the new discount rate to recalculate the MVPE. The percentage change in the MVPE is the IRR proxy.

To compute present values, the OTS model categorizes the assets and liabilities on the balance sheet into 30 categories of securities; each category is characterized by similar responses to changes in interest rates. The book value for each category is then broken down into different time horizons or "buckets" by the maturity or repricing date of the security. The maturity for all securities is assumed to be the midpoint of each bucket unless otherwise stated. For each bucket, in each category, future cash flows are estimated and discounted to compute a present value. Cash flows for each bucket may include interest, principal, and prepayment. The discount rate is determined by internal rate of return or option adjusted spread, depending on the sensitivity of the cash flows to changes in interest rates. The exact present value methodology for each security is detailed below. After computing the MVPE based on the existing term structure, the MVPE is recomputed for a shocked term structure. The shocked term structures used for regulatory purposes are parallel shocks of 200 basis points (bp) both upward and downward. The percentage changes in the MVPE resulting from the term structure shocks provide measures of IRR for both upward and downward movements in the term structure.

The data available for this dissertation is significantly different from the data available for previous failure prediction studies. The data is from the quarterly Thrift Financial Report (TFR) beginning in 1985:3 and ending in 1989:12.[3] The TFR includes standard financial forms and section H, a maturity and yield table. Section H reports seven balance sheet assets and six balance sheet liabilities and subdivides each category into seven maturity "buckets". The buckets are 0-6 months, 6-12 months, 1-3 years, 3-5 years, 5-10 years, 10-20 years, and 20-30 years. For each bucket the corresponding yield or cost is also reported.

[3] The MVM was designed in conjunction with the data requirements of the 1990 TFR. The data used in this study is quite similar, but not identical. Hence, the MVM has been modified slightly to accommodate the data.

The next section explains the two methods for determining a discount rate. Then, the model for the term structure of interest rates is explained. The final section defines each security category and provides a detailed explanation of the present value methodologies.

3.1 Discounting Methods

The discount rate is the sum of the Treasury curve and a risk premium. The OTS MVM employs two methods for determining a discount rate depending on the interest sensitivity of the cash flows. If cash flows do not fluctuate with interest rates, the discount rate is determined by internal rate of return. If cash flows are interest sensitive, the OTS uses an option adjusted spread (OAS). A problem with the internal rate of return is that it does not account for uncertain cash flow. Thrift assets include many mortgage related securities with embedded options that affect their cash flows. For mortgage securities, these options may take the form of caps, floors, or prepayments. The value of these options is dependent on interest rates.

The OAS methodology computes the risk premium for a representative security, with a known market price, for numerous simulated interest rate paths. The MVM uses the following present value (PV) equation:

$$PV = \lim_{N \to \infty} \frac{1}{N} \sum_{j=1}^{N} \sum_{i=1}^{n} \frac{CF_{i,j}}{(1 + r_{i,j} + OAS)^{i/12}}, \tag{3.1}$$

where, N is the number of independent interest rate paths (200 paths are used for the MVM), n is the number of periods, r_i is the annual spot rate at time i, OAS is the representative securities risk premium, and CF_i is the interest sensitive cash flow for period i. The present value of the security is equal to the average present value for all 200 unique interest rate paths. By considering numerous interest rate paths, an accurate distribution of option values is included in the calculation. A constant OAS is added to each spot rate, causing a parallel shift, to reflect the additional risk of the representative security. The constant spread is determined by an iterative process, where an initial OAS is guessed and then repeatedly adjusted until the average present value is acceptably close to the market value.[4] Using this OAS and the previous equation, the present value of any security similar to the representative security is calculated.

The internal rate of return model is used for all categories of assets and liabilities whose cash flows are not interest rate sensitive. Again, a risk premium is computed for the representative security, but for only one interest rate path. The standard present value formula is as follows:

$$PV = \sum_{i=1}^{n} \frac{CF_i}{(1 + r_i + rp)^i}, \qquad (3.2)$$

where, n is the number of periods (years, months, etc.), r_i is the spot rate for period i (expressed as a per period rate), rp is the risk premium for the representative security, and CF_i is the interest sensitive cash flow for period i. The risk spread is again solved for using an iterative process, this time over only the current term structure. An initial value is guessed and this value is adjusted until the present value is sufficiently close to the market or par value of a representative security. The spread is used to value securities of

[4] The OAS is estimated in two passes to reduce computer time. First, only twelve paths are used through five iterations. Second, the result from the twelve paths is used with the 200 paths and iterated to within a discount rate of .5%.

risk similar to the representative security in the internal rate of return present value equation.

3.2 Interest Rate Model

The interest rate model is governed by two arbitrage conditions. First, the risk neutral short rate path distribution must reflect the current term structure. Second, as the term structure moves through time a dynamic arbitrage condition ensures that two equally risky portfolios have the same expected return. These two conditions are met using a parsimonious model for the current term structure developed by Nelson and Spiegel (1987) and a model for the path of short interest rates developed by Brennan and Schwartz (1980). The Nelson and Spiegel model is used for the single discount path with the internal rate of return and used to standardize the 200 paths of the OAS model. The Brennan and Schwartz model forecasts the 200 unique paths used in the OAS, such that each path is consistent with historical parameters of the short rate movement.

Nelson and Spiegel (1987) introduce a parsimonious model that is diverse enough to represent the variety of shapes generally associated with yield curves: monotonic, humped, and S shaped. They let the instantaneous forward rate at maturity m be the solution to a second-order differential equation with real and unequal roots. The yield to maturity on a bill, denoted R(m), is the average of the forward rates, which integrates to,

$$R(m) = \beta_0 + (\beta_1 + \beta_2)[1 - \exp(-m/\tau)]/(m/\tau) - \beta_2 \exp(-m/\tau), \tag{3.3}$$

where, τ is a time constant selected for best fit, and β_0, β_1, and β_2 are determined by initial conditions. The limiting value of R(m) as m gets large is β_0 and as m gets small is $(\beta_0+\beta_1)$, which are necessarily the same for the forward rate function since R(m) is just an averaging of the forward rate.

The time constant, τ, represents how quickly the regressors decay. Small values of τ correspond to rapid decay and provide a better fitting yield curve at short maturities, but are unable to fit excessive curvature at longer maturities. Correspondingly, large values of τ correspond to slow decay in the regressors and provide a better fit over longer maturity ranges, but they will be unable to follow extreme curvature at short maturities.

Using bills for their study, Nelson and Spiegel (1987) avoided some of the difficulties associated with coupon bonds, such as differential rates of taxation for coupon income and capital gains. Although the term structure is fitted using short term data, it is necessary to test the predictive power of the model on long term bonds. The actual and predicted bond prices are highly correlated at .963, but it is also clear that the predictions overestimate the actual prices. This suggests the fitted curves may flatten out too quickly. Similarily, estimating inverted yield curves, the models overshoot long-term discount rates and therefore underestimate the price of the bonds. A cubic polynomial fits the data on bill yields slightly better and it has the same numver of parameters as Nelson and Spiegel's model. However, at longer maturities a cubic polynomial will shoot toward either plus infinity or minus infinity. The correlation between actual and predicted bond price is -.020, so the polynomial model has no predictive value, although it fits the sample data very well. In this test the Nelson and Spiegel (1987) model is clearly superior to a cubic polynomial in predicting bond price.

Using the Nelson & Spiegel model and Treasury prices for maturities of 3 months, 6 months, 1 year, 2 years, 3 years, 5 years, 7 years, 10 years, and 30 years from CitiBase, the model parameters are estimated at December 31, of each year, from 1985 to 1989. Model error is minimized over different values of τ to obtain the best fitting coupon Treasury yield curve.[5]

For discounting, the zero coupon Treasury curve is used, so the above coupon yields are used to generate the zero coupon spot rates in the following equation:

$$r_n = \left(\frac{1 + r_c}{1 - \sum_{i=1}^{n-1} \frac{r_c}{(1 + r_i)^i}} \right)^{\frac{1}{n}} - 1, \tag{3.4}$$

where, r_c is the yield to maturity of a coupon bond selling at par with maturity n and r_i is the zero coupon spot rate for i periods. The zero coupon spot rates are calculated sequentially starting with the first period, six months. Using the calculated zero coupon spot rates, the Nelson & Spiegel model is used to determine the optimal zero coupon yield curve over several values of τ.[6] In the present value equations, the zero coupon yield curve plus a risk spread is used as the discount rate.

Forecasted term structures must be consistent with the probable movement of the short term market rate. Brennan and Schwartz (1980) developed a model to generate the

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[5] The following values of τ led to the best fitting Treasury curves: $\tau=24$ for 1985, $\tau=24$ for 1986, $\tau=6$ for 1987, $\tau=6$ for 1988, and $\tau=6$ for 1989.

[6] The following values of τ led to the best fitting zero coupon Treasury curves: $\tau=20$ for 1985, $\tau=20$ for 1986, $\tau=4$ for 1987, $\tau=4$ for 1988, and $\tau=1$ for 1989.

path of short term interest rates with a mean reverting drift term and heteroskedastic variance. Chan et al. (1992) found this model to have the lowest Chi-square among the models they tested. A discrete time version of their model is as follows:

$$r_{t+1} - r_t = \alpha + \beta r_t + \varepsilon_{t+1}, \qquad (3.5)$$

$$E[\varepsilon_{t+1}] = 0, \text{ and}$$

$$E[\varepsilon^2_{t+1}] = \sigma^2 r_t^2,$$

where, r_t is the one month Treasury rate at time t. Parameters are estimated using a one month Treasury series from January 1956, to December 1985. The Treasury series is from the Center for Research on Securities Prices. The ordinary least squares estimates/(t-statistics) are α = .007201/(7.876), β = -.09932315/(4.858), and σ = .151327.[7]

Although the random short term interest rate paths generated by the Brennan and Schwartz (1980) model all start from current short term Treasury rates, there is no guarantee that the 200 n-month sequences of short rates used for discounting will, on average, exactly return the n-month zero coupon Treasury price estimated previously. The ability of the short rate distribution to explain current Treasury prices is a necessary requirement for model consistency. The generated distribution is adjusted to exactly price the currently observed zero coupon Treasuries. Beginning with month 1 and continuing to month 360, the number of basis points that causes the distributions average zero coupon Treasury value of the 200 paths to equal the value estimated by the Nelson and Spiegel

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[7] Weighted least squares estimates are similar.

(1987) model is added to (or subtracted from) all short rates at that month. The resulting short rate distribution is thus consistent with the current zero coupon Treasury curve.

3.3 Account-Specific Present Value Methodologies

The OTS MVM divides the securities of savings and loan balance sheets into different categories, each with a slightly different present value methodology. Descriptions of discounting techniques used are in section 3.1. The following is a description of the methodology used for each thrift account.

3.3.1 Asset Methodologies

To compute the present value of fixed rate mortgage (FRM) loans and securities for 1-4 family dwellings, the reported book value is multiplied by the appropriate multiplier from a price sensitivity table. Each multiplier converts one dollar of book value into a present value, which is a function of the maturity and coupon of the mortgage and the appropriate term structure scenario. Table 3 shows the FRM price sensitivity table for December 1985.

The multiplier for each FRM is the average present value of future cash flows over the 200 interest rate paths. The cash flows are the sum of the standard payment calculation for amortized debt and the prepayment equation as stated below. The amortized debt payment given the present value is

$$R = \frac{PVA_{mn} * \frac{r}{m}}{1 - \frac{1}{\left(1 + \frac{r}{m}\right)^{mn}}} \tag{3.6}$$

where, R is the regular periodic annuity payment, PVA_{mn} is the present value of an annuity of mn periods, r is the annual nominal interest rate, and m is the number of compounding periods. For each month, the outstanding loan balance must be computed based on the previous month's prepayment. Each multiplier is computed using an OAS risk premium. The representative securities for FRMs are Federal National Mortgage Association (FNMA) 30 year, fixed rate, mortgage backed securities, with coupons ranging from 7% to 14%. The mortgage price data was obtained from the Bloomberg System.

Prepayment models vary significantly in complexity. The historical data on which they are based is never sufficient to accurately predict the future. In spite of this, the OTS prepayment model for fixed rate mortgages adequately describes prepayment using only three factors: seasoning, seasonality, and refinancing. The equations for this model are as follows:[8]

$$CPR_t = R_t * Z_t * S_t. \tag{3.7}$$

$$R_t = 0.1828 - .0892 \text{ Arctg } (4.776 (-C/m_{t-3} + 1.083)),$$

$$Z_t = t/30 \text{ for } t<30 \text{ months; 1 thereafter, and}$$

$$S_t = 1 + .20 \sin [3.1415/2((\text{month} + t\text{-}3)/3\text{-}1)],$$

where CPR_t is the constant prepayment rate at month t, R_t is the prepayment resulting from the refinancing incentive, Z_t is the seasoning variable, S_t is the monthly seasonality factor, C is the mortgage coupon, and m_t is the current mortgage rate. The mortgage rate is the short rate at month t+60.

[8] The prepayment model for the OTS MVM and the OTS Net Portfolio Value Model (NPVM) are similar except the MVM requires informaiton on previous prepayment rates. The equations used in this study are from the NPVM.

The present value for adjustable rate mortgages (ARM) is also computed as the product of the reported book value and a multiplier from a price sensitivity table. The price sensitivity table is broken down by index, maturity, current yield, and term structure. The adjustable coupon is set equal to a margin plus a market rate index. Indexes used are 1, 3, and 5 year Constant Maturity Treasuries (CMT) and correspond respectively to buckets with repricing at months 6 and 12, 24, and 48. Current yields range from 7% to 14%. The reset frequency is the length of time between resetting the variable rate coupon. The reset frequency matches the index with the first reset at half of the index, period caps and floors are 2%, and lifetime caps and floors are set at 6%. The margin is chosen as follows for each index: 1 year index, 275 bp; 3 year index, 240 bp; and 5 year index, 200 bp. The cash flows are the sum of the amortized payment and the prepayment using a variable index to compute the payment. The MVM uses a prepayment model identical to the fixed rate model except for one factor. The refinancing variable is specified:

$$R_t = .4072 - .2267 \mathrm{Arctg}(8.45((-C_t/m_{t-3}) + 1.253)). \quad (3.8)$$

With these assumptions, a representative security is used to compute a representative OAS. The price quotations for the representative security, a one year CMT, are obtained from the Wall Street Journal.

For ARM maturities greater than five years the balances are treated as FRM's with a balloon payment. Principal and interest are computed as though the mortgage had a maturity of thirty years. The prepayment equation and the OAS are identical to those used for valuing a FRM. The balloon payments are paid at the actual maturity: 7.5, 15, or 25 years.

"Other mortgages" includes construction loans, permanent mortgages on multi-family residential property and nonresidential property, and land loans. The present value is found with discounted cash flows because cash flows are assumed interest insensitive. The cash flows are the sum of the amortized payment and a prepayment. The prepayment is identical to the prepayment of a fixed rate mortgage. The spread is unique for each mortgage type but constant over the forecast period. A discount spread is computed for each type of "other mortgage" and the weighted average spread is used to discount the aggregated cash flows. The weights are determined from firm specific balance sheet accounts. A maturity of ten years is assumed for the representative securities. The representative securities are the Barrons / Levy Commercial Mortgage index for permanent mortgages and prime plus 300 bp for land loans.

Other mortgage securities repricing within one year are treated as adjustable rate securities. To compute the standardized discount spread, assume the maturity is 10 years, the margin is 300 bp, and the reset is 12 months except the first reset at month 7. The index is computed by adding a basis to the short rate. The basis is assumed to be half the difference between the short rate (1 month) and the mortgage rate (5 years). The equation for prepayments is the same as that for adjustable rate mortgages. Upon determining the spread, present values are computed with all of the above assumptions except maturity is taken as the weighted average of the 5 longer buckets.

The category "second mortgages" includes all closed-end junior liens, revolving open-end liens, and junior lien loans on 1-4 family dwelling units. The present value is computed by discounting monthly cash flows by the Treasury curve plus a spread. Cash flows are equal to the monthly amortization payment plus the prepayment. The prepayment is the fixed rate mortgage prepayment plus 2% annually. The spread is computed by valuing a security whose interest rate is equal to the current first mortgage rate plus a 100 bp premium, where price equals par, and whose maturity equals thirty years.

The shortest two buckets are considered to be adjustable rate second mortgages. The spread is based on the following assumptions: prepayment is identical to adjustable rate mortgages plus 2% annually, the reset equals the index except the first reset is at month 7, the margin is 300 bps, and the index equals the short Treasury rate plus a basis that is half the difference between the short rate and the mortgage rate. After computing the spread, all assumptions stay intact except maturity which is now the weighted average of the five long buckets.

"Consumer loans" includes the following: loans on deposits, home improvement loans, education loans, auto loans, mobile home loans, other commercial loans including leases, revolving loans secured by 1-4 family dwelling units, and unsecured loans including credit cards. The cash flows used in the static discount cash flow model are constant monthly interest payments computed as the product of the reported rate and the account value. The category discount spread is the weighted average of individual security spreads. Security spreads are determined by setting the account value to par and using current market yields to establish the spread. These current yields are as follows: for loans on deposits, the 6 month certificate of deposit (CD) yield plus 100 bp; for home improvement loans, the first mortgage rate plus 200 bp; for education loans, the 3 month

T-bill yield plus 300 bp; and for the remaining consumer loans, the yields on Federal Reserve Release G.19. Maturities for these accounts are as follows: loans on deposit, 2 years; home improvement loans, 10 years; educational loans, 3 years; auto loans, 4 years; other personal loans, 2 years; and mobile homes, 10 years.

The shortest consumer loan bucket is treated as though composed of adjustable rate loans. The short bucket weights of each type of consumer loan are assumed identical to the weights of fixed rate consumer loans and the maturity of the adjustable rate loans is considered equal to the weighted average maturity of the fixed rate loans. The spread is the same for fixed and adjustable rate consumer loans.

"Commercial loans" includes secured and unsecured commercial loans and financing leases. Economic value is computed using the static discounted cash flow model. Maturity is the midpoint of each bucket. Cash flows are constant interest payments equal to the face amount multiplied by the reported rate of return. To calculate the spread, use the Federal Reserve Release E.2, "Survey of Terms of Bank Lending", rate to calculate cash flows. Then, set the face amount equal to one. Assume maturity to be 48 months for fixed and adjustable rate commercial loans.

The shortest bucket is assumed composed of adjustable rate commercial loans. The margin and index used to compute the spread are the same as for adjustable rate consumer loans. Again, the maturity to compute the economic value is the weighted average of the fixed rate loans.

The category "Investment securities" includes US Treasury securities, municipal bonds, investment grade corporate debt, and preferred stock. Cash flows are semiannual interest payments generated by multiplying principal balances by the reported weighted average portfolio rates and the return of principal at maturity. Static discount cash flows are used with no additional risk spread to compute the present value.

3.3.2 Liability Methodology

"Borrowings" includes Federal Home Loan Bank (FHLB) advances, redeemable preferred stock, and subordinated debentures, and others. The present value is equal to the cash flows discounted by the wholesale CD yield. Monthly cash flows are the sum of interest outflow and the return of balances at maturity. Monthly balances are assumed constant for each bucket until maturity, which is the bucket midpoint. For discounting cash flows beyond 6 months the spread between the 6 month CD and 6 month zero coupon Treasury is added to the zero coupon Treasury.

Retail and wholesale CDs use the static discount cash flow method. Cash flows are equal to expiring balances and discount rates are wholesale CD yields. In addition, retail CDs have a non-interest cash flow for maintenance, and wholesale CDs have a one month interest penalty per year for early withdrawal. Except for the early withdrawal of wholesale CDs, retail and wholesale balances retire at maturity, which is equal to the bucket midpoint.

"Core deposits" includes transaction accounts, money market deposit accounts, and passbook accounts. Cash flows are the sum of interest costs, non-interest costs, and attrition. All balances are assumed to expire after 300 months. Static discount cash flow calculates the present value of these cash flows. The discount rate is the wholesale CD yield as used for previous securities.

Various measures of interest rate risk, including SHORT and ISF, have been shown useful in various tests related to equity values. In spite of their success many previous authors have acknowledged their shortcomings. This is particularly true when considering the complexities of a thrift's asset--liability portfolio. The OTS MVM should provide more and better information on the relationship between interest rate movements and thrift capital.

CHAPTER 4 - THE FAILURE PREDICTION MODEL

4.1 Introduction

Depository Institutions' (DIs) asset maturities and liability maturities are significantly different, which leads to a high degree of interest rate sensitivity.[9] During the early and mid 1980's, the interest rate environment was unfavorable toward the banking and thrift industry. Many thrifts failed because of excessive interest rate risk. Lately, risk based capital standards have received significant attention from government regulators and Congress. Interest rate risk (IRR) is included in the risk evaluation of the firm and used to compute adjustments to the capital standards. Historically, methods used to measure IRR have been simple balance sheet ratios. Recently, due to more frequent thrift failure and increasing emphasis on IRR based capital standards, new measurement techniques, in particular the Market Value Model (MVM), have been developed and employed. This study compares the Market Value Model to proxies for IRR using simple balance sheet ratios in measuring interest rate risk and predicting thrift failure. Further, this study tests for an interactive effect between capital and IRR.

Failure prediction studies show which characteristics of a firm are related to thrift failure. IRR may have a positive impact on thrift capital during periods of decreasing interest rates, but in general is considered detrimental to thrift solvency. Bovenzi et al. (1983), Barth et al. (1985), and Cole (1993) show an IRR variable significant in predicting

[9] Flannery and James (1984) and Sweeney and Warga (1986) and others show interest sensitivity of financial institutions.

thrift failure. The first objective of this study is to confirm these findings on the relationship between thrift failure and interest rate risk.

A simple proxy for interest rate risk is the difference between the amount of assets and liabilities maturing in one year, standardized by the total assets (SHORT). Bovenzi et al. (1983) successfully use a similar proxy to predict failure. Barth et al. (1985), successfully use the ratio of interest sensitive funds to total liabilities (ISF) in failure prediction. Both of these measures have been used successfully in various studies, but neither sufficiently account for the unique characteristics of a thrift's asset and liability portfolio. Realizing the potentially severe consequences of IRR, regulators of banks and thrifts have developed more comprehensive risk measures. These measures consider not only the maturity and coupon of portfolio securities, but also any option characteristics such as prepayments. The Office of Thrift Supervision (OTS) developed the MVM especially for the purposes of measuring interest rate risk and determining risk based capital standards.[10] The IRR measure generated by the MVM is theoretically and technically superior and should overshadow the balance sheet ratios. The second objective of this study is to determine the cumulative ability of all three IRR proxies to predict failure.

Adding an interest rate risk component to risk based capital standards was a result of the Federal Deposit Insurance Corporation Improvement Act (FDICIA). (The final rule was effective January 1,1994, except for a few amendments.) According to the Federal Register:

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[10] The Federal Reserve Bank has developed an IRR measure along similar lines as the MVM, but it is not as sensitive to the interest rate options inherent in mortgage securities.

> Effective control of interest rate risk is critically important to the safe and sound operation of savings associations. To protect the insurance fund and to create appropriate incentives for prudent risk management, thrift's capital requirements must explicitly take account of interest rate risk exposure.

The Federal Register continues by providing a general outline of the requirements of the regulation. The introduction of this regulation is based on the common result that capital level is negatively associated with propensity to fail.[11]

There are several hypotheses that suggest a non-linear relationship between capital and propensity to fail. First, equity is an option on firm assets. Increasing leverage (decreasing capital) implies a greater sensitivity to firm risk, including IRR. Second, Brickley and James (1986) suggest that firms about to fail, become less sensitive to risk, as a result of potential government laxity. Next, high capital may signal superior management skills and management may alter IRR to their benefit. Also, Cole et al. (1994) suggest high IRR firms will overestimate book net worth and be less sensitive to net worth levels. Finally, if capital levels are sufficiently high to endure interest rate cycles, the detrimental effects may be avoided completely. Several interactive variables are used to test for variable sensitivity of IRR and capital over other firm variables. The final objective of this study is to test the significance of several interactive terms.

In summary, IRR is positively correlated with thrift failure. Comparing the different IRR proxies tested, the balance sheet ratio, SHORT, performs similarly to the MVM proxy. Using all three proxies, multiple IRR variables are found significant, suggesting more than one variable is appropriate to accurately measure IRR. Finally,

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[11] Sinkey (1978), West (1985), Altman (1977), Barth (1989), Benston (1985), and Pantalone and Platt (1987) show capital negatively related to failure. James (1991) shows capital negatively related to failure losses.

consistent with the idea of superior management, the interactive term shows high capital firms less detrimentally affected by interest rate risk.

This chapter is organized as follows. The next section reviews the industry environment and the literature on using an IRR variable as a predictor of thrift failure. The research methodology is explained in the third section including a brief explanation of the MVM. The fourth section reviews the results. Section five discusses the theoretical motivation and results for an interactive term. The final section interprets and summarizes all the results.

4.2 Review of the Industry and the Literature

4.2.1 Industry Review

During the 1980's, thrift failure occurred at unprecedented rates. Prior to the 1980's, thrifts failed at a rate of three per year. According to Barth et al. (1989), from 1980 through 1985 almost 600 thrifts failed. This list of failures includes liquidations, assisted and unassisted mergers, conservatorships, and management consignment programs.[12] During the sample period of this test, 1986 through 1991, about 900 thrifts failed, almost 300 in 1990 and about 200 in 1989 and 1991.[13]

In an economy where thousands of thrifts fail, predicting which thrift specific variables forecast thrift failure is insufficient. External factors must also be evaluated to understand the causes of failure. The macroeconomic factors influencing the thrift failures

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[12] Liquidations are the sale of the failed thrift's assets. Mergers occurred both with and without financial assistance. Conservatorships and management consignment programs are similar and represent a transfer of managerial responsibilities to regulatory authorities.

[13] Closure for this test is represented by conservatorships, conservator-like programs, and receivership. Receivership is a change of ownership.

in the late 1980's include unfavorable interest rate conditions and perverse risk incentives created by regulation.[14] In the late 1970's, interest and inflation rates were at historical highs. To control these rates, the Fed changed monetary policy which created even higher rates and more volatility. Since banks and thrifts use predominantly short-term liabilities, this rate increase dramatically increased the cost of their short-term funding. Interest rate ceilings limited banks' ability to pay market rate returns on deposits and other intermediaries with lower regulatory overhead were able to offer higher rates of return. This caused what is commonly referred to as disintermediation, as investors moved their funds from banks to non-bank intermediaries. Rising interest rates also had a detrimental effect on thrift assets. Banks, in particular thrifts, have long maturity assets which are very interest rate sensitive. The rising rates caused significant decreases in the market value of thrift assets. A secondary impact of these problems was negative net interest margins, as liability cost increased above asset return. Negative net worth often resulted, as the value of thrift assets decreased by more than the equity value.

The perverse risk incentives were the result of inefficient regulation and took two forms. Table 1 describes the recent regulations that compounded the incentive problem. The first form, federal deposit insurance premiums were constant across firm type regardless of firm risk.[15] Riskier firms, which have a higher probability of loss, paid the same premium as low risk firms. This encouraged firms to bear excessive risk because the

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[14] Moral hazard as a cause of failure is discussed in Kane (1989); Barth, Bartholomew, and Labich (1989); Barth et al. (1989); Benston and Koehn (1989); Cole (1990a,1990b); Barth and Brumbaugh (1994) and McKenzie, Cole, and Brown (1992) and others.

[15] Prior to FIRREA, thrift deposit insurance premiums were 12.5 basis points per year. After FIRREA these premiums rose to 23 basis points, but were still a flat rate. FDICIA introduced a variable rate deposit insurance premium, which was based on the firms capital level and its supervisory rating.

thrift owners would receive the increased upside potential of the extra risk and the insurance fund would bear the increase in downside risk.[16] Second, capital requirements were not risk adjusted. Firms were regulated according to maximum leverage, but the riskiness of the assets was not considered in determining acceptable amounts of leverage. Again, firms with riskier assets would provide a higher upward potential for equity holders and the greater downward risk would be transferred to the deposit insurance fund at no cost to the thrift owners. This gave thrift owners an incentive to over-invest in risky assets. These two risk incentives were particularly relevant when firms were insolvent or almost insolvent.[17] A healthy firm avoids excessive risk because of the detrimental impact it may have on firm capital. If capital levels are depleted, this disincentive is absent.

In response to the severity of DI risk in the U.S. and similar concerns across the globe, risk measures were included in various regulations. Depository insurance premiums were restructured to include firm riskiness. Globally, capital standards were set with consideration for the asset risk of the DI. The general premise of risk based capital standards is that as thrift risk increases the required capital level increases. Capital provides a buffer against failure, hence increasing the capital level counteracts increasing asset risk. Recently, these risk-based capital standards have been extended by FDICIA to include IRR. Hence, as firm IRR increases, the capital requirement increases. Although

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[16] Burnett, Rao, and Tinic (1991) show low risk firms subsidize high risk firms with a flat rate deposit insurance premium.

[17] This problem is further compounded by a policy of forbearance which the regulators implemented throughout much of the 1980's. See Kane and Yu (1994) or Cole (1993).

implementation of this concept has been long awaited, the actual details are actively debated.[18]

4.2.2 Summary of Failure Prediction Studies

In an effort to analyze firm characteristics associated with failure, researchers have repeatedly employed a failure prediction methodology. A summary of these studies is provided in Table 2. Generally, these studies use a binomial dependent variable, failure and health. The exact definition of failure is based on accounting numbers and may change over time depending on regulators' funding and the health of the thrift industry.[19] Firm specific accounting ratios are the most common independent variables.

The dependent variable for most tests has been problem status or failure. The meaning of failure has changed over time. Initially, when failures were few, it meant book value insolvency. Now as failures have become too numerous for regulators to promptly close, failure is more aptly interpreted as closure, because banks stay open well beyond book value insolvency. Some of the recent literature reflects this by renaming these studies as closure prediction.[20] Alternately, other studies have predicted book value insolvency.[21] Market value insolvency is the best dependent variable for most studies, because it eliminates accounting misvaluations and adjusts for regulatory behavior. For non-public firms, market value data is not available. An alternative continuous market

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[18] The OTS currently uses the Net Portfolio Value Model, NPVM, as a measure of IRR. The NPVM has many similarities to the model used in this study. O'Brien (1992, 1993) and Cordell and Gordon (1992) compare the OTS model to the FRB model.

[19] The regulators' closure rule may also be relaxed by increases in size or percentage conventional assets, by Federal vs. state charter, by stock vs. mutual ownership, or by southwest vs. other districts. See Cole (1993).

[20] See Barth et al. (1989), Thomson (1992), and Cole (1993).

[21] Cole (1993) compares the determinants of failure prediction to the determinants of closure prediction. There is almost complete overlap in significant variables between the two models, but the weights of these variables are much different for the two tests.

measure of the degree of failure is the amount of loss thrifts incurred. Barth, Bartholomew and Bradley (1990) predict the resolution costs of thrift institutions. James (1991) predicts the losses realized in bank failures.

The independent variables with the most significance in predicting failure and problem status are related to the categories implied by the CAMEL acronym: capital, asset quality, management efficiency, earnings ability, and liquidity.[22] Rose and Kolari (1985) suggest liquidity and loan risk exposures are two probable indicators of commercial bank failure. Pantalone and Platt (1987b) find that higher earnings and equity ratios are a signal of health. Altman (1977) successfully uses management efficiency as a determinant of savings and loan problem status. Sinkey (1978) shows that the net capital ratio is the most significant classification variable. The efficient market hypothesis suggests all accounting information is included in the market price. Pettway (1980) tests the predictive ability of market price and finds lower stock price returns two years before failure.

Additionally, IRR has been shown to be a significant predictor of failure. Bovenzi et al. (1983) use the difference between market rate assets and market rate liabilities divided by equity capital as an interest rate sensitivity variable. The variable improved the classification of the model, but the efficiency and credit risk variables were more informative. Bovenzi suggests this lack of significance may indicate that interest rate risk is not the most critical problem facing banks or it may indicate this interest rate sensitivity variable is not an accurate indicator of a bank's interest rate risk. Barth et al. (1985) find the interest sensitive funds variable (ISF) the most predictive of the three interest rate variables they test.

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[22] More recently, the thrift regulators have used a similar acronym, MACRO.

4.3. Methodology & Data

4.3.1 IRR & MVM

The intent of this research is to compare different IRR measures in predicting thrift interest rate risk and thrift failure. IRR measures the value change of interest sensitive securities resulting from interest rate changes. Generally, interest sensitive securities are those with specific contracted cash flows.[23] A bond with contracted coupon and maturity cash flows is a good example. When interest rates, and correspondingly the discount rate, increase (decrease), cash flows are discounted at a higher (lower) rate, and the bond value decreases (increases). The value change is greater when contracted cash flow duration is longer; hence, long-term bonds have more IRR than short-term bonds.

A depository institution (DI) may be viewed as a portfolio of interest sensitive securities. The assets are mostly long-term loans and the liabilities are mostly short-term deposits. When rates move up, the value of long-term assets decreases more than the value of short-term liabilities. Since net worth is the difference between assets and liabilities, the interest rate increase causes a decrease in net worth. When rates move down, the net worth increases. The larger the maturity mismatch between assets and liabilities, the greater the effect on net worth. In support of this relationship, Samuelson (1945) suggests interest rate sensitivity depends on the mismatch of balance sheet cash flows. Thrifts' primary assets are thirty year home mortgages which subjects thrifts to a larger maturity mismatch than other DIs. Although IRR will increase net worth when

[23] The nominal contracting hypothesis suggests securities with contracted cash flows are interest sensitive because of the rigidity of their cash flows (French et al. 1983). Flannery and James (1984) are the first to apply this theory to financial institutions.

interest rates decrease, it increases the variance of its capital level and increases the probability of insolvency.

Measures of portfolio IRR usually include information on the maturity mismatch between assets and liabilities. SHORT adheres directly to this guideline, but ISF is based only on the liability side of the balance sheet. Thrift asset characteristics vary more than thrift liability characteristics, but the omission of the assets in the ISF measure should be detrimental to its performance. Regardless of their simplicity, both SHORT and ISF have been shown significantly related to failure and provide a benchmark for evaluating more complex IRR measures.

Saunders (1994) suggests IRR is composed of both a market value effect and a net interest income effect. The regulator's model should account well for the market value effect, while the balance sheet ratios are orientated around the income effect. The second objective of this study is to compare the ability of the different IRR variables to predict failure. The IRR measure generated by the MVM is more comprehensive and should provide more predictive ability. Since balance sheet ratios measure predominantly the income effect, they may provide additional information for firms or periods where the income effect dominates the market value effect.

There are five IRR variables tested: three generated by the MVM and two simple balance sheet ratios. They are defined as follows:

SHORT = (short-term liabilities - short-term assets) / total book assets[24]

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[24] Short term assets include those assets repricing or maturing in less than one year according to section H of the TFR. Short term liabilities include liabilities repricing or maturing in less than one year. A similar proxy standardized by market equity is used by Bovenzi et al. (1983) and Flannery and James (1984a). Market equity is not available for most thrifts and book equity may be very small or take negative values biasing the variable results.

ISF = interest sensitive funds / total funds[25]

Uchg = ($MVPE-MVPE_u$) / Market Value of Assets

Dchg= ($MVPE_d$-MVPE) / Market Value of Assets

Achg= (MVPE- $MVPE_a$) / Market Value of Assets

where

$MVPE_i$- Market Value of Portfolio Equity under interest rate scenario i

u - 200 b.p. upward shock

d - 200 b.p. downward shock

a - actual shock using following December 31 term structure.

Note that each IRR is designed such that it is predominantly positive and increasing with more risk.

4.3.2 Failure Prediction

My methodology is similar to that of previous failure prediction studies. The logit model is used over the entire population of thrifts. The binary dependent variable, failure, is proxied by firms that entered receiverships, conservatorships, or similar programs and has a value of one. The independent variables selected are those which have been found significant in previous studies. The independent variables are generally represented by the CAMEL acronym, with the addition of an IRR proxy and interactive variables between capital and IRR.

The failure prediction model is as follows:

$$Fail_j=\Phi(X_j, \beta, \varepsilon_j) \quad j = 1, 2, \ldots, N, \qquad (4.2)$$

[25] Interest sensitive funds include short term FHLB advances, short term other borrowings, and deposit balances less than $100,000.

where $Fail_j$ is equal to one if an institution failed and zero otherwise, Φ is the logit maximum-likelihood operator, X_j is a vector of independent variables representing the CAMEL acronym and an IRR proxy, β is a vector of parameter estimates for the independent variables, ε_j is a normally distributed random distribution term with zero mean and unit variance, and N is the number of observations. The results from these regressions are in Tables 10 through 35. Each table shows the results of six regressions; one for the pooled sample and one for each of the five years.

Variables representing the CAMEL acronym found significant in previous studies are included to reduce specification error. Since accounting variables are integrally related, an accounting based IRR proxy may inadvertently proxy for other firm risks. This would bias the results of the proxy and the importance of IRR. Including variables representing the CAMEL acronym will reduce the probability of misspecification. Each risk represented by the CAMEL acronym is proxied by several variables. To determine the information each variable adds, it is substituted into a base set of CAMEL variables. The base variables representing the CAMEL acronym are capital (net worth / total assets),[26] asset quality (repossessed assets / total assets), management efficiency (non-interest expense / total assets), earnings ability (net income / total assets), and liquidity (amount eligible for regulatory liquidity / total assets).[27] The likelihood ratio index (LRI) measures regression performance. An increase in LRI resulting from a substitution of a

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[26] An alternate specification of this proxy is exp (net worth / total assets). This alternate specification is less skewed and more closely fits the normality assumption of the logit model.

[27] Amount Eligible for Regulatory Liquidity- includes Insured or Guaranteed by an Agency or Instrument of the United States (A070), Accrued Interest Receivable (A090), Cash and Demand Deposits (A360), U.S. Government and Agency Securities (A370), Common and Preferred Stock (A382), Other Investments (A384), and Accrued Interest Receivable (A390).

CAMEL variable implies an improved specification of that variable. The optimal CAMEL variables are those that maximized the LRI over each different variable. The various specifications of each CAMEL and IRR are listed below along with their expected sign.

The specifications and expected signs are as follows:

Independent Variables	Expected Sign
Capital- net worth / total assets	(-)
- MVPE / market assets[28]	(-)
- MVPE / total assets	(-)
- exp (net worth / total assets)	(-)
Asset Quality- repossessed assets / total assets	(+)
- other assets / total assets	(+)
- percentage change in median real estate prices	(-)
Management Efficiency- non interest expense / total assets	(+)
Earnings Ability- net income / total assets	(-)
- interest income / interest expense	(-)
Liquidity- amount eligible for regulatory liquidity / total assets	(-)
- brokered deposits / total assets	(+)
- cash and securities / total assets	(-)
Interest Rate Risk- Uchg	(+)
- Dchg	(+)
- Achg	(+)
- ISF	(+)

[28] Market assets is the estimated market value of assets as computed by the MVM.

- SHORT (+)

This study will estimate parameters using year-end financial statement data from 1985 through 1989. Failed thrifts are from either the following calendar year or the subsequent year, months thirteen to twenty-four. For example, if ten thrifts fail in 1986, estimation procedures use the data from the ten failed firms and the nonfailed firms from, December 31, 1985. This tests failure zero to twelve months into the future, year one failures. To evaluate the significance of the independent variables with a longer time until failure, the above regression is run with failures from months thirteen to twenty-four, year two failures. For example, independent variables from December 31, 1985, will be used to predict the failures in 1987. Failure data is from 1986 to 1991. Year one and year two failures are predicted from each of the five years individually, but a year by year analysis may be significantly affected by temporary phenomena and may not show consistent results. The five years of Thrift Financial Report (TFR) data are pooled to form a single data base of approximately 15,000 observations.

Outliers were eliminated for impossible or excess values. Excess values are those more than four standard deviations from the mean. About 300 observations are eliminated. Net worth / total assets is restricted to values greater than or equal to -1. MVPE / market assets is restricted to values greater than -1. MVPE / total assets is restricted to values greater than -1. The repossessed assets ratio is restricted to values greater than or equal to 0 and less than or equal to 1. Other real estate / total assets is restricted to values greater than or equal to 0 and less than 1. Non-interest expense / total assets is restricted to values greater than or equal to 0. Net income / total assets is restricted greater than -1. Interest income / interest expense is restricted to values greater than or equal to 0. Amount available for regulatory liquidity is restricted to values greater than or equal to 0 and less than 1. Uchg is restricted to values greater than -.1. Achg is restricted to values greater than -.89. SHORT is restricted to values between -.8 and 1. ISF is restricted to values greater than 0 and less than or equal to 1.

Using a single IRR variable in each regression provides information on the individual performance of the variable. Including all three IRR variables will provide more information on their cumulative performance. The results from regressions including all three IRR variables are in Tables 38 and 39.

4.3.3 Data

The data for independent variables is from the Thrift Financial Report from year-end, 1985 through 1989.[29] Section H of this report provides the maturity and yield data necessary to compute the MVM.[30] The failure data is compiled from lists provided by the Federal Deposit Insurance Corporation (FDIC) and OTS.

4.4 Results

This section provides results for two tests. The first verifies the previous result that IRR is positively correlated to thrift failure. This result is verified over year by year data and over the appended five year data set. Further, various specifications for the

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[29] Observations are eliminated based on eligitimate or excessive values for any variable. Eligitimate variables are those which are non-sensical based on the possible values. Excessive variables are those which exceed approximately four standard deviations from the mean of the entire sample.

[30] The MVM also required data on the one month Treasury which was obtained from CRSP, on the Treasury yield curve which was obtained from CitiBase, and for category market securities which were obtained from many different sources.

CAMEL variables are compared over both the single and five year data sets. Based on the regressions using the pooled sample, optimal CAMEL and IRR variables are identified. Then this optimal set of variable specifications is tested. Next, a failure prediction model with all three IRR variables is tested to confirm which IRR proxy is the most significant and to analyze IRR performance using multiple proxies. This test is only on the five year data base. Each of these failure prediction tests uses failures in the twelve months following the TFR data (year one) and failure in the thirteen to twenty-four months following the TFR data (year two). Table 8 shows the median, mean, and standard deviation of the variables tested.

For the first test of the failure prediction model, a base set of CAMEL variables is used as a standard of comparison. In each regression, a single variable is changed. The results are then compared to the results for the base model to determine the best specification of each variable. Each table includes results for six regressions. Only the results for the pooled sample are discussed.

In Table 9, the year one results for the base CAMEL and base IRR variable are shown. Four CAMEL variables, CAEL, and Uchg are of the correct sign and significant. The management variable is of the correct sign but only of marginal significance. The management variable is seldom significant in these regressions. The likelihood ratio index (LRI) for this regression is .273. The year two results for the base CAMEL and base IRR variables are shown in Table 10. These results show all five CAMEL variables and Uchg of the correct sign and significant when predicting failure. The LRI for this regression is .168.

The results for the base CAMEL variables with the Dchg IRR variable are shown in Tables 11 and 12 for year one and two respectively. For year one failures, the four CAMEL variables, CAEL, and Dchg are of the correct sign and significant. For year two failures, all five CAMEL variables and the IRR are correctly signed and significant. Compared to Uchg, the variable Dchg slightly decreases the LRI for year one and increases the LRI for year two.

The IRR variable, Achg, is included with the base CAMEL variables in the next two tables. Table 13 has year one results. The four CAMEL variables, CAEL, and Achg are significant and the LRI is slightly higher than for Uchg. Table 14 shows the year two results that the five CAMEL variables and Achg are significant and that the LRI is again slightly higher than that for Uchg. However, Achg is not an ex ante measure, but uses ex post interest rates. This result shows a small improvement in performance when actual interest rate changes are used instead of a hypothetical parallel shock.

ISF, interest sensitive funds divided by total assets, replaces the previous IRR in a regression with the base CAMEL variables. These results are in Tables 15 and 16. For year one failures, the regression including ISF shows significant CAMEL and IRR variables except for the management variable. The LRI decreases slightly, hence Uchg is still a more informative IRR variable. With year two failures, the CAMEL variables are all significant, but ISF has an incorrect sign. The LRI's for Uchg and ISF are identical.

The final IRR variable tested, SHORT, the difference between short term liabilities and short term assets divided by total assets, is included with the base CAMEL variables. The results on Tables 17 and 18 show the four CAMEL variables, CAEL, and the five

CAMEL variables significant for year one and year two failures respectively. SHORT is significant in both years. The LRI for SHORT is identical to the LRI for Uchg in both years.

Table 19 has results for using an alternate capital specification, MVPE divided by market assets. All five CAMEL variables and the IRR are significant and the LRI is .278 compared to .273 with the base capital variable. Table 20 shows the corresponding results for year two failures. All five CAMEL variables and the IRR are significant and the LRI is again improved over the base model from .168 to .170.

Another specification of the capital variable, MVPE over total assets, is evaluated next. All five CAMEL variables and the Uchg IRR variable are significant in both years. The LRI improves in both years to .288 for year one and to .174 for year two failures. These results are shown in Tables 21 and 22.

The most informative capital specification is exp (net worth / total assets). This capital specification reduces the impact of extreme values and creates a more normal distribution. When included with the other base CAMEL variables and Uchg, all variables are significant and the LRI is .291, the highest LRI of any single alternate specification. For year two failures, all CAMEL variables and Uchg are significant and the LRI rises to .177. These results are shown in Tables 23 and 24.

An alternate specification for asset quality is other real estate[31] divided by total assets. For year one failures, the inclusion of this variable with the other base CAMEL variables and Uchg shows Uchg and the three variables, CEL, significant and a decrease in LRI to .270. This result is in Table 25. For year two failures, the inclusion of the

[31] Other real estate is the physical assets owned by the financial institution as overhead.

alternate asset variable shows Uchg and all five CAMEL variables significant and a decrease in LRI to .156. This result is in Table 26.

Percentage change in real estate value is the best specification of asset quality. Table 27 shows the four CAMEL variables, CAEL, and Uchg significant with an LRI of .277. Table 28 shows the five CAMEL variables and Uchg significant with an LRI of .172 for year two failures.

Table 29 has results using interest income over interest expense for the earnings variable. The four CAMEL variables, CAML, and Uchg are significant in predicting year one failures, but the LRI is very low at .258. Table 30 shows CAML, the four CAMEL variables, and Uchg significant for year two failures, again with a very low LRI at .166.

An alternate liquidity specification is brokered deposits over total assets. Results are in Tables 31 and 32. When included with the other base CAMEL variables and the base IRR proxy, CAEL, the four CAMEL variables and Uchg are significant. When included in the regression predicting year two failures, all base CAMEL variables and Uchg are significant. The LRIs for year one and year two failures are .254 and .143 respectively. In Table 33, the base CAMEL and Uchg variable are included with another alternate liquidity variable, cash and securities over total assets. The results of this regression predicting year one failures shows the four CAMEL variables, CAEL, and Uchg significant. The results of this regression, predicting year two failures, shows the five CAMEL variables and Uchg significant. This result is in Table 34. The LRIs for this alternate variable are .254 and .140 for year one and year two failures respectively.

The results of the previous regressions suggest the optimal CAMEL specification for year one and year two failures includes the following variable specifications: exp (net worth / total assets), percentage change in median real estate value, non-interest expense divided by total assets, net income over total assets, and amount eligible for regulatory liquidity divided by total assets. For the two year failures, ISF has the wrong sign and SHORT is slightly more significant then Uchg. Uchg is the optimal one year IRR proxy and indistinguishable from SHORT in performance for year two. Uchg will be used as the optimal year two IRR proxy. Table 35 shows the results of year one failures using the pooled data set. This regression has the highest LRI of .297 for any six variable, CAMELI, specification. The four CAMEL variables, CAEL, are significant as well as Uchg. Table 36 shows the result of year two failures using the pooled data set. For this regression, all five CAMEL variables and ISF are significant.

Evaluating the sign and significance of the independent variables for individual years shows that significance varies widely and even signs are somewhat volatile. For example, the sign of the IRR variable is frequently wrong in 1985 and 1986, but generally insignificant. This may suggest an inferior proxy or changing sample properties. Proxies may vary in their ability to measure failure causing risks; better proxies may solve the problem. Also, economic factors could affect the significance of accounting ratios. Including economic variables or interactive terms between economic factors and accounting ratios in the regression may increase parameter consistency. If certain economic factors are more significant in a given year, then an associated risk measure may be more significant. For example, when interest rates are high and volatile IRR is a greater threat to thrift health. A complication is that economic variables probably have a longer cycle than one year. Alternatively, parameter significance may vary because of an arbitrary closure rule. This may be corrected by using an accurate market value estimate of equity for the closure rule or by using failure loss or net income as the dependent variable.

The second test evaluates the comparative and additive abilities of three IRR proxies: Uchg, ISF, and SHORT. For each regression either the base or optimal CAMEL variables are included with all three IRR proxies. If several of the IRR proxies are significant, this suggests that interest rate risk may best be explained by multiple measures. Table 37 shows the results of predicting year one failures with the base and optimal CAMEL variables along with the three IRR proxies. In the regression with base CAMEL variables, the four variables, CAEL, are significant. Uchg and SHORT are significant and ISF is marginally significant. In the regression with the optimal CAMEL variables, the four CAMEL variables, CAEL, are significant. Uchg is the only significant IRR variable. ISF is marginally significant and SHORT is insignificant. With the base CAMEL variables, several IRR measures are significant and provide information on the IRR of the firm. With the optimal CAMEL variables, ISF is marginally significant and may provide additional IRR information over that provided by the Uchg measure.

Table 38 shows the results for base and optimal CAMEL variables with the three IRR proxies for predicting year two failures. All of the base CAMEL variables are significant. Uchg is marginally significant. SHORT is insignificant and ISF has the wrong sign. All the optimal CAMEL variables are also significant. The results for the IRR variables with the optimal CAMEL variables are Uchg is clearly significant and SHORT and ISF are insignificant. These results suggest that for year two failures Uchg provides the most information on IRR.

4.5 Interaction Term

Risk based capital standards require higher capital levels as a result of higher IRR levels. Higher capital levels have been found by Sinkey (1978) and others to be negatively related to failure. Increasing capital standards for firms with high IRR effectively neutralizes the IRR and returns the probability of failure to acceptable levels. Alternatively, firms with lower capital are more sensitive to IRR. The following theories analyze this association. Further, the theories are applied to a potential interactive effect between IRR and asset size.

The first theory of interaction between capital level and the effect of IRR is the leverage theory. Low capital is a result of high leverage. The equity of leveraged firms is an option on the value of firm assets and the equity has a greater volatility than the volatility of the assets. This suggests that as capital increases IRR should have a lower impact on the probability of failure. Similarly, as IRR decreases, the sensitivity of thrift failure to capital level should decrease.

Brickley and James (1986) suggest that government guarantees may reduce the co-movement of S&L stock returns with their underlying assets. During periods of financial distress, regulators may not fail a technically insolvent thrift in hopes it will recover without government expenditure. This regulatory leniency provides a free option to insolvent thrifts. Hence the market value is buoyed up by the value of the free option provided by regulators and market value sensitivity of vulnerable DIs to risk is reduced. Vulnerable DIs include poorly capitalized firms and firms with excess IRR. According to Brickley and James, both of these firm characteristics should be associated with lower sensitivity to risk. Hence, low capital firms should be less sensitive to IRR. Further, as IRR increases and the probability of failure increases, the value of government leniency increases which would make capital less beneficial for high risk firms. As the probability of government intervention increases with higher risk levels, the value of capital is supplanted by government laxity. Therefore for high IRR firms, the coefficient for capital should be negative, but less significant for low IRR firms. Finally, as firm size increases, government laxity becomes more significant and more probable; hence, IRR or other risk becomes less influential.

Alternatively, high capital levels may be a signal of management quality. If higher capital is a signal of superior management, then thrifts with higher capital levels should be more resilient to the detrimental effects of IRR. A well-managed firm may hedge risk if they predict an upward movement in interest rates and, alternatively, leverage risk if they predict a downward movement in interest rates. Thus a well-managed firm, that correctly predicts interest rates, may reduce its sensitivity to IRR and even use IRR to its benefit. As IRR or firm risk increases, the value of good management increases. As the firm's position becomes more precarious, the value of good decisions is more important. For higher risk levels the capital variable should be more significant. Finally, larger firms can afford better and more management. Their ability to deal with IRR should be superior.

For example, large firms should have less costly hedging tools. Therefore, larger firms should be less sensitive to IRR.

Cole et al. (1994) suggest, following periods of rising interest rates, the book value of net worth more severely overestimates the value of net worth for firms with higher IRR. The greater the IRR the greater will be the effect of interest changes. Book value net worth is negatively related to failure. High IRR firms will show a less negative relationship to net worth.

Alternatively, high capital levels may increase the long-run stability of the firm. Since interest rates mean revert, a detrimental upward shift in rates is usually followed by a beneficial decrease in rates. If a firm has sufficient capital to endure the cycle, the effect of IRR may be temporary, hence nonexistent at the cycle's end. Therefore, firms with high capital levels should be less sensitive to IRR. Also, large firms would have increased access to capital and liquid assets and could endure adverse business cycles easier than smaller firms with fewer options. For larger firms, increased capital access or increased liquidity access may serve as a temporary substitute for high capital level. Larger firms should be less sensitive to IRR.

There are four specifications for interactive effects. The first interactive term is the product of IRR and capital level. The capital level is specified as exp(net worth / total assets) to eliminate negative capital values and to give the interactive term a more manageable distribution and interpretation. The second specification is the product of Uchg with sequential capital level dummies. The sequential capital dummies represent the following capital levels: $C1 < 0$, $0 \leq C2 < .02$, $.02 \leq C3 < .05$, and $.05 \leq C4$. The next interactive effect is measured by the product of capital with sequential dummies for Uchg. The dummies for Uchg are for the following levels: IRR < .02, .02 ≤ IRR < .04, and .04 ≤ IRR. The final specification is the product of Uchg and asset level dummies. The asset levels are less than 100 million, between 100 million and 1 billion, and greater than 1 billion.

To test the interactive effects, the failure prediction model is as follows:

$$\text{Fail}_j = \Phi(Y_j, \beta, \varepsilon_j) \quad j = 1, 2, \ldots, N, \tag{4.3}$$

where Fail_j equals one if an institution fails and zero otherwise, Φ is the logit maximum-likelihood operator, Y_j is a vector of independent variables representing the CAMEL acronym and interactive terms, β is a vector of parameter estimates for the independent variables, ε_j is a normally distributed random distribution term with zero mean and unit variance, and N is the number of observations.

The expected sign on the product between Uchg and capital level is negative. The other expected signs are as follows.

Capital Level Dummies (increasing)

Theory	IRR sign	Trend
Leverage	(+)	decreasing
Regulatory Leniency	(+)	increasing
Management Proxy	(+/-)	decreasing
Overestimated Net Worth	(+)	not applicable
Cyclical Interest Rates	(+/0)	decreasing

IRR Level Dummies (increasing)

Theory	Capital sign	Trend
Leverage	(-)	not applicable
Regulatory Leniency	(-)	increasing
Management Proxy	(-)	decreasing
Overestimated Net Worth	(-)	increasing
Cyclical Interest Rates	(-)	decreasing

Asset Level Dummies (increasing)

Theory	IRR sign	Trend
Leverage	(+)	not applicable
Regulatory Leniency	(+)	decreasing
Management Proxy	(+)	decreasing
Overestimated Net Worth	(+)	not applicable
Cyclical Interest Rates	(+)	decreasing

Tables 39 through 43 show the results for regressions including the base CAMEL variables, an IRR variable, and the product of IRR and capital. The results for year one failures are on Table 39. There is a separate regression for each of the three IRR variables: Uchg, ISF, and SHORT. For all three regressions, the IRR and the three CAMEL variables, AEL, are significant. Management is marginally significant with the Uchg variable but not significant otherwise. Using SHORT, the capital variable is significant. With ISF or Uchg, the capital variable is not significant. The IRR variable and the interaction term are significant with Uchg and ISF. IRR is expected to be positively correlated with failure, as more risk increases the probability of low capital levels. The interaction term shows the sensitivity of failure to IRR is a decreasing function of capital. Surprisingly, with SHORT the IRR and interaction term have the wrong sign and this LRI is the highest of the three.

Table 40 uses the base CAMEL variables and shows the results for each regression predicting year two failures. The four CAMEL variables, AMEL, are significant in each of the three regressions. For year two failures, the capital variable performs similarily to the capital variable for year one failures, over each IRR. Also, the sign and significance of the IRR variables is the same for year one and year two failures. The Uchg and ISF variables and their corresponding interactive terms are significant with the correct sign, but SHORT and the corresponding interactive variable are the wrong sign. The LRI of the SHORT regression is .219, the highest of the three IRRs.

Tables 41 and 42 present the results for the regressions including the interactive term, but use the optimal CAMEL variables in place of the base CAMEL variables. Using the optimal CAMEL variables increased the LRI for each regression in both years, but did not reduce the superiority of SHORT with a LRI of .352 for year one and .229 for year two. Predicting year one failures shows the four CAMEL variables, CAEL, significant in each regression. With the optimal CAMEL variables, the performance of the IRR and interactive variables is unexpected. Each variable in all three regressions is insignificant. Predicting year two failures the results are identical except the management variable is also significant.

As an alternative to the interactive product, sequential dummy variables multiplied by Uchg are used to distinguish non-stationary IRR sensitivity over different capital levels. This result is in Table 43. A different dummy variable is used for each of the groups: less than 0%, 0% to 2%, 2% to 5%, and greater than 5%. Base and optimal CAMEL variables, Uchg, and the product of the dummies and Uchg are used to predict year one failures. The three CAMEL variables, CEL, are significant in the regressions with either CAMEL proxies. The management variable is marginally significant in both regressions and the asset quality variable is significant only with the optimal CAMEL variables. Uchg and each Uchg dummy are significant for both CAMEL specifications. The hypothesis that the parameters for each dummy variable are equal is rejected by a likelihood ratio test. The test statistics are 984.6 for the base CAMEL variables and 857.4 for the optimal CAMEL variables. For three degrees of freedom, using the Chi-squared distribution these statistics are significant at the one percent level. The results for these variables suggest that IRR is most detrimental for low capital level firms. Both high capital level groups show a negative correlation between failure and IRR suggesting that for high capital firms IRR is beneficial. The LRI for both regressions is above .400, the best of any regressions. The AIC, which accounts for the number of parameters in the regression, is the most favorable of all regressions. Table 44 shows that the parameters for the three lower capital levels are significantly different than the parameter for the high capital level.

Table 45 considers the sensitivity to IRR over different size categories. Included in the regressions are the base or optimal CAMEL variables along with Uchg and asset level dummies representing the size categories: less than \$100,000,000, between

$100,000,000 and $1 billion, and greater than $1 billion. Predicting year one failures, both regressions show the four CAMEL variables, CAEL, significant. The Uchg variable is significant in both regressions. The Uchg dummy representing the smallest firms is marginally significant with the base CAMEL variables and significant with the optimal CAMEL variables. The Uchg dummy for intermediate size firms is marginally significant for both CAMEL specifications. The hypothesis that the parameters for each dummy variable are equal is not rejected by a likelihood ratio test. The test statistics are 2.3 for base CAMEL variables and 3.2 for optimal CAMEL variables. For two degrees of freedom, using the Chi-squared distribution these statistics are not significant. This is an unexpected result. Larger firms should have the resources to better manage IRR. The 'too big too fail' hypothesis suggests large firms have a lower propensity to fail. My results do not support this hypothesis. A possible explanation for this is prior to this period more large insolvent thrifts were kept operating than small insolvent thrifts, due to the greater costs of failing large firms; possibly, this period is characterized by a reversal of this trend and an increase in large thrift failures. Table 46 shows variables similar to Table 45, except the size dummies confirm the results of the likelihood ratio test that the IRR response of the largest and smallest groups of thrifts are not significantly different. The results using optimal CAMEL variables are similar.

In Tables 47 and 48, a series of IRR dummy variables test for a non-constant sensitivity of failure to capital, over different levels of IRR. Three different capital specifications are tested: net worth / total assets, MVPE / market, and exp (net worth / total assets). Using net worth / total assets, failure has a decreasing sensitivity to capital as IRR increases. Table 48 shows that each IRR group has significantly different capital sensitivity, but only when using the net worth / total assets specification. The hypothesis that the parameters for each dummy variable are equal is rejected by a likelihood ratio test only for the capital specification, net worth / total assets. The test statistics are 6.3 for net worth / total assets, 1.7 for MVPE / market assets, and 0.4 for exp(net worth / total assets). For two degrees of freedom, using the Chi-squared distribution the statistic for net worth / total assets is significant at the five percent level. The regression results further show the three CAMEL variables, AEL, significant as well as the Uchg variable.

Table 49 includes all specifications of all CAMEL and IRR variables as well as a hedging variable and a size variable. All capital variables are significant with exp (net worth / total assets) most significant. Repossessed assets and percentage change in real estate are significant with the best performance by the latter. Management has the correct sign. Net income / total assets is the only consistently significant earnings variable and amount eligible for regulatory liquidity is the only consistently significant liquidity variable. Surprisingly, the hedging variable is positive and significant in all three regressions suggesting those firms with the most hedging devices had a higher probability of failure. Size is also shown positively correlated to failure. Uchg is significant in all three regressions and clearly outperforms balance sheet ratios.

4.6 Summary

In contrast to previous failure prediction studies, the performance of the capital variable is inconsistent in this study. The inconsistency may result from technically insolvent firms that are not failing. Further, several interactive terms include capital level as a factor and may reduce the information provided by the capital variable. The CAMEL variables performed as expected in the majority of regressions regardless of the IRR variable.

In support of our predictions, IRR is positively correlated with failure for all IRR measures. An argument to the contrary is, during interest rate declines, a firm with high interest rate risk should benefit. This argument finds some support when regressions are run for specific years with decreasing rates, but not over the full five year sample. The theoretically and technically superior MVM performs similarly to the balance sheet ratio SHORT when the IRR proxies are used individually or together. Although SHORT includes information on thrift asset maturity, it does not distinguish between different long term maturities and different security characteristics. The performance of ISF is good for year one failures; this is surprising considering that it is a liability side ratio. The performance of the MVM is probably detrimentally affected by a failure rule that depends on accounting versus market values and a policy of forbearance. Using a consistent and timely market measure of insolvency should improve the comparative performance of Uchg.

Using three IRR variables provides information on the additivity of the IRR information. Predicting year one failures, Uchg, ISF, and SHORT are positive and significant. This suggests multiple measures of IRR are helpful in determining risk exposure and may be useful in risk based capital standards. The t-statistics in this regression show SHORT most significant.

The results with the interactive variables appear to provide support for risk based capital standards. As the level of capital increases, the detrimental effect of IRR is reduced. This suggests a dual benefit of higher capital. The first benefit of capital is as a buffer against equity loss. The second benefit is that as capital increases, the sensitivity to IRR decreases. For the two highest capital levels, IRR is negatively associated with failure. The relationship between high capital and IRR may result from more efficient management. If this is the case, requiring higher capital levels will not improve management effectiveness and may not reduce the sensitivity of failure to IRR. Another implication of the results of the interactive variables is that for high capital levels, IRR increases the probability of health. Hence, a high capital firm has a lower probability of failure with higher IRR. Brickley and James suggest during financial distress government intervention may buoy up capital values. During the sample period for this test, the regulators may have tightened their closure rule, eliminating any previous value from regulatory laxity. This would explain the IRR sensitivity of the two lower capital levels, but not the beneficial response of the higher capital levels. Similarly, the leverage argument can explain higher sensitivity for low capital levels, but not the beneficial sensitivity for highly capitalized thrifts. Management quality is the only hypothesis which justifies the current result on the interaction between capital and IRR.

Different size firms are shown to have similar sensitivity to failure from IRR. This is a surprising result and not suggested by any of the hypothesis stated here. A possible explanation is a reversal of the regulatory leniency / too big to fail hypotheses. This time period may be characterized by regulator responsibility. The prompt response of regulators may have removed the market value gains resulting from leniency. This may be particularly true for large firms where lenient regulator behavior was more probable. This is supported by a proxy for firm size shows significant and positive correlation to thrift failure.

Interest rate risk is shown to impact the sensitivity of failure to capital level when capital is measured with book values. Two hypotheses may support this result: overestimated net worth and regulatory leniency. The regulatory leniency is rejected in this time period in other tests, hence the overestimation of net worth hypothesis may best explain why firms with high IRR levels are less sensitive to capital. Further, this hypothesis is based on book value measurement of capital which suggests the insignificant results with non-book measures of capital do not contradict the hypothesis.

CHAPTER 5 - TWO INDEX MODEL

Depository institution (DI) stock returns have been shown to be sensitive to an interest rate index. The primary explanation for this result is the nominal contracting theory. Inherent in this theory is the suggestion that maturity mismatch increases interest rate sensitivity. Thrifts have significant maturity mismatch and should show a significant interest rate index and subsequently a significant interest rate risk (IRR) proxy. Using a two index model, both coefficients are shown in the literature to be significant in predicting DI stock returns.

5.1 Introduction

The most prevalent of the theoretical explanations suggesting interest sensitivity for DI stock returns is the nominal contracting hypothesis.[32] The nominal contracting effect is compounded by the maturity mismatch problem. The impact on a nominal long maturity financial contract is greater than the impact on a short maturity contract. Thrift assets are often long-term fixed rate contracts and their liabilities are short-term liabilities. When interest rates rise, the values of both contracts go down, but the long-term contract will lose much larger percentages of its market value. Thrift market value of equity is the difference between the market value of assets and liabilities. Hence when interest rates rise, asset value decreases more than liability value and market equity decreases.

[32] French et al. (1983) originate this hypothesis. Flannery and James (1984) are the first to use the hypothesis in connection with the interest rate sensitivity of financial institutions. A more thorough discussion of the relevance of this hypothesis is found in the Flannery and James paper.

Maturity mismatch measures the difference between asset maturity and liability maturity. Flannery and James (1984) and others have used SHORT, market rate assets minus market rate liabilities standardized by market equity, as a maturity mismatch proxy.[33] Another balance sheet measure of maturity mismatch is interest sensitive funds (ISF), those funds that will reprice within one year standardized by total funds.[34] Uchg is the Office of Thrift Supervision's measure of maturity mismatch and considers maturities for all asset and liability cash flows including those which are interest rate options. It is technically and theoretically superior to balance sheet ratios and should provide the most accurate measure of maturity mismatch.[35]

5.2 Methodology

The two index market model examines the relationship of both a market and an interest rate index with stock price returns. The two index model is as follows:

$$R_{jt} = \beta_{0j} + \beta_{mj}R_{mt} + \beta_{Ij}R_{It} + \varepsilon_{jt}, \tag{5.1}$$

where,

R_{jt} - the excess holding period return to the j^{th} stock or portfolio over the month ending at time t,

R_{mt} - the excess holding period return on the S&P 500 over the month ending at time t,

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[33] Bovenzi (1983) and Tarhan (1984) also use this measure.

[34] Barth et al. (1985) use this measure of maturity mismatch to predict failure.

[35] Maturity mismatch is the difference between asset maturity and liability maturity and is used as an IRR proxy. This discussion uses maturity mismatch as a synonymn for IRR proxy.

R_{It} - the excess holding period return on an index of constant maturity default-free bonds over the month ending at time t,[36] and

ε_{jt}- error term.

The relationship between stock price and an interest rate index is well established, including a relationship between interest sensitivity and a maturity mismatch factor. Maturity mismatch is a measure of interest rate risk (IRR). The intent of this research is to extend our understanding of the dependence of the interest rate coefficient on an IRR factor and to determine which IRR factor is most predictive.

There are two tests of this relationship; the first is a two stage test. The first stage runs the two index model, which verifies the relationship between the stock of financial institutions and interest rate movement. The second stage regresses the interest rate index coefficient onto the IRR measure as follows:

$$\beta_{Ij} = \alpha_0 + \alpha_1 IRR_j + \nu_j, \qquad (5.2)$$

where,

IRR_j - the j^{th} portfolio's or S&L's average IRR over the test period[37],

SHORT - (market rate liabilities minus market rate assets) / total assets[38],

ISF - interest sensitive funds / total funds,

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[36] These interest rates are the unexpected changes in interest rates obtained by using the residual of an AR(3) model. Flannery and James (1984), Tarhan (1984), and others use similar methodology. Previous studies have orthogonalized the market or the interest rate index, but this biases t-statistics. Giliberto (1985) discussed this issue in depth and concludes the unorthogonalized model provides unbiased results. These tests use unorthogonalized indices.

[37] Average IRRs are the average of IRRs over the months that data was available for the portfolio or stock. For example: the average IRR for a firm trading from June 1986 to September 1989 would be the average IRR over that specific trading period.

[38] Short is standardized by total assets instead of market equity, which is more common in the literature because the market equity data is not available for the entire sample. Also, book equity takes negative and very small values and would make the variable distribution volatile.

Uchg - $(MVPE_u - MVPE)$ / estimated market assets, and

ν_j - error term.

Savings and loans (S&Ls) are grouped into portfolios by similar characteristics to test interest sensitivity of specific groups of firms. Portfolios are formed by total assets, net worth percentage, and thrift assets as a percentage of holding company assets.

The second test combines the two stages into a single regression as follows:

$$R_{jt} = \beta_{0j} + \beta_{mj}R_{mt} + \beta_{zj}(R_{It}*IRR_j) + \beta_{Ij}R_{It} + \varepsilon_{jt}, \qquad (5.3)$$

where,

R_{jt} - the excess holding period return to the j[th] stock over the month ending at time t,

R_{mt} - the excess holding period return on the S&P 500 over the month ending at time t,

R_{It} - the excess holding period return on an index of constant maturity default-free bonds over the month ending at time t,

IRR_j - the j[th] S&L's average IRR over the test period,

SHORT - (market rate liabilities minus market rate assets) / total assets,

ISF - interest sensitive funds / total funds,

Uchg - $(MVPE_u - MVPE)$ / estimated market assets, and

ε_{jt}- error term.

The interest rate index is the return on a portfolio of bonds. When interest rates rise, bond prices decrease and the return index is low. Rising interest rates cause a similar decrease in S&L asset values leading to low S&L equity returns. Hence, the return on the interest rate index is expected to be positively correlated to the return on S&L common stocks. In the second stage of this test, interest rate sensitivity is regressed onto an IRR proxy. As IRR or maturity mismatch increases the responses to changes in interest rates, interest rate sensitivity, should be larger. Hence, the coefficient of the IRR proxy is expected to be positive. The expected signs for the coefficients for portfolios or individual stocks are:

Independent Variable	Expected Sign
Two Index Model (Stage one)	
Market Index	(+)
Interest Rate Index	(+)
IRR Model (Stage two)	
IRR Proxy	(+)
Single Stage Model	
Market Index	(+)
Interest Rate Index	(+)
Interactive Term - $(R_{It}*IRR_j)$	(+)

The return data for the these tests are monthly returns from the Center for Research on Security Prices (CRSP). All firms are on the New York Stock Exchange, American Stock Exchange, or National Association of Securities Dealers Automated Quotation system with at least 3 years of consecutive return data from 1986 through 1990. The data for the market, interest rate, and risk-free indices are from Ibbotsen and

Associate's Encorr. The balance sheet data for the IRR measures are from the Thrift Financial Report, December, 1985-1989.

5.3 Results

Preliminary tests on the interest sensitivity of DI stock prices are not supportive of previous results or the corresponding theory. Results are in Table 50. The tests used the two index model to determine the interest sensitivity of equity portfolios of savings and loans. The savings and loan portfolios are found not sensitive to an interest rate index. These results are consistent over short, long, and mortgage rate indices. The coefficient of the long index is insignificant and the short index coefficient is significant with the wrong sign. The market index is significant with the expected sign and magnitude.

Table 51 shows the results of the single stage regression. The market index is consistently significant with a coefficient estimate of slightly less than .6. The interest rate index is insignificant as in the two stage model. Finally, for both interest indices and all three IRR proxies the interaction term between the interest index and the IRR proxy is insignificant.

The literature frequently suggests hedging as an explanation for a lack of sensitivity. If the S&Ls have hedged their interest rate risk, they will not respond to movements in the interest rate index. Table 49 shows results for a hedging variable in a failure prediction test. This test shows hedging securities positively correlated to failure. This result is appropriate when interest rates are decreasing. The period of this study is characterized by mildly fluctuating rates with no large increases. Hedging benefits the firm during periods of increasing rates. Although hedging instruments were legal over the sample period, even the larger thrifts did not use substantial amounts of hedging instruments. Hedging securities may have provided limited portfolio diversification.

Along similar lines, off-balance sheet items may have played a role in reducing interest sensitivity. Kane and Unal (1990) show on and off-balance sheet items have opposite responses to changes in interest rates. If the sample period is characterized by higher amounts of off balance sheet items or greater sensitivity to these items, then DI's may not be sensitive to interest rate changes. Data on off-balance sheet items are only available for the final year of the test period. Swaps are included in off-balance sheet items and are a good example of an instrument which would reduce interest rate risk. For example, an S&L may exchange assets with fixed interest payments for assets with variable interest payments. However, Kane and Unal (1990) show even through various changes in interest rate sensitivity, the off-balance sheet effect never dominates the on-balance sheet effect.

Brickley and James (1986) show risk sensitivity is muted by a lag in regulatory intervention. As a firm approaches failure, its capital value is inflated and its interest rate sensitivity may be reduced if regulators actions are delayed or neglected. This problem should not apply to well capitalized firms that are in no danger of failing. A portfolio of firms with capital levels above 5% (HIGHCAP) and a portfolio of intermediate capital levels between 2% and 5% (MEDCAP) showed no interest sensitivity. Hence delayed intervention does not explain the lack of interest sensitivity.

Non-synchronous trading may be a problem when dealing with small firms as in the S&L industry. This phenomenon has a tendency to affect the magnitude and significance of the market model coefficients. However, in most tests the market beta was of the correct magnitude and significance. Regardless, to correct for this potential problem the monthly returns were compounded into quarterly returns. The returns were still unresponsive to interest rate changes. Secondly, the firms were separated by total assets, above and below one billion dollars, under the assumption that larger firms trade more frequently and are less likely to suffer a bias from non-synchronous trading. This also failed to produce positive sensitivity to the interest rate index in either the high or low asset portfolio (HIGHAST and LOWAST respectively).

Since the stock price may be from a holding company which through non-bank subsidiaries diversifies its interest rate sensitivity. Moody's Banking and Finance Manual was used to verify the percentage of holding company assets which were related to a savings and loan. A portfolio of firms with savings and loan assets representing at least 85% of their holding company assets (HCRTNS) shows no sensitivity to interest rates.[39]

Finally, many of the previous studies on the two index model use a sample period from the late 1970's to early 1980's when interest rates were exceptionally volatile and high. The sample period in this study, 1985 through 1989, is characterized by moderate interest rates and interest rate movements. Moderate interest rate behavior may be more easily managed by thrift managers. The market may not incorporate the impact of these moderate interest rate movements into stock price because of industry wide management

[39] Flannery and James (1984) and Tarhan (1984) use the same methodology to show thrifts sensitive to interest rates.

ability or because the minimal impact of interest rates in this moderate environment may be lost amidst stronger economic influences or the complexities of computing corporate cash flows from the cash flows of its underlying assets.

The results using an Ibbotsen portfolio of S&Ls contrasts the results from the CRSP data. The Ibbotsen quarterly portfolio started in March, 1986 and the test period concluded in December, 1990. The results of the two index model using this portfolio show a positive and significant interest rate beta for both long and short rate indices. This is consistent with theory, but contradictory to every test run with the CRSP data. Apparently, firm selection is critical in evaluating interest rate sensitivity. Although all logical firm characteristics are controlled for, our sample did not demonstrate interest rate sensitivity.

CHAPTER 6 - CONCLUSION

Using either failure prediction or the two index market model, previous studies have shown interest rate risk (IRR) to be positively correlated to the variability of capital level. Failure prediction tests have shown IRR positively correlated to thrift failure. The two-index market model has shown thrift stock price sensitive to changes in interest rates. Further, the sensitivity is shown proportional to maturity mismatch, which is a measure of IRR. The results for the failure prediction tests are verified here, but the results for the two index market model are not supported by this study.

The failure prediction model shows which variables are positively related to thrift failure. Various CAMEL (capital, asset quality, management ability, earnings strength, and liquidity) specifications are shown to have the expected correlation to failure. Each of the IRR variables tested is shown to be positively correlated to failure. When multiple IRR variables are included, several are shown significant. Including interaction terms shows that thrift sensitivity to IRR and capital varies over firm characteristics.

Various specifications of the CAMEL acronym are tested to see which specification performs best. The better performance may be a sample specific result, but may indicate a superior variable measure. The capital variable is the most critical and is specified by four different proxies. The performance of all three alternate proxies is superior to the base proxy. The base proxy, net worth / total assets, has a high standard deviation that may detrimentally affect its performance. The alternate specification, exp (net worth / total assets), is designed specifically to reduce the standard deviation and it performs as well as any of the capital variables. Asset quality is proxied best by the percentage change in median real estate values. Unlike the other CAMEL and IRR variables, this variable is based on the regional economy. The management variable is marginally significant over the failure prediction tests. Interest income over interest expense is the best earnings variable. The best liquidity variable is the amount eligible for regulatory liquidity over total assets. This variable includes Treasury securities and may also proxy for asset safety. The inclusion of the CAMEL variables is to reduce specification error. Omitting the CAMEL variables, an IRR variable may inadvertently proxy for other firm characteristics. Including the various CAMEL variables as non-IRR measures, reduces the risk of specification error and improves the reliability of the test results.

When included with the base CAMEL variables, each of the IRR variables tested is significant in predicting failure. The Achg yields the highest LRI, but Achg is an ex post proxy for IRR using the year end term structure following the failures. Uchg performs as well as the other IRRs, but does not definitively outperform any of them. In the tests including the base CAMEL variables, the extra effort and data required for the Uchg and Dchg variables does not yield a superior performance. Although SHORT includes information on thrift asset maturity, it does not distinguish between different long term maturities and different security characteristics. The performance of ISF is surprising considering that it is a liability side ratio. In spite of these imperfections, these balance sheet ratios performed well. The performance of the MVM is probably detrimentally affected by a failure rule that depends on accounting versus market values. It may be that the failure rule is actually in error. This test would support the use of any of these IRR measures for risk based capital standards.

When Uchg, SHORT, and ISF were included in the regression with the base or optimal CAMEL variables, Uchg is significant, ISF is marginally significant, and SHORT is significant depending on which CAMEL variables are used. These regressions suggest that the information these IRR variables provide is additive. The implications for risk based capital is that it may be advantageous to include more than one proxy to determine thrift IRR. Further, in support of Uchg, it is consistently the most significant IRR proxy when all three are included and as the regression explains more variation its significance increases, while that of the balance sheet ratios remains constant or decreases.

Interactive terms are included as a product of two variables or as the product of a variable and sequential dummies for a second variable. The product of IRR and capital level shows how the sensitivity of failure to capital changes over different IRR levels. For higher IRR levels, this variable suggests that capital is a more significant deterrent to failure. Alternatively, it may be interpreted that for higher capital levels IRR has a beneficial effect. This is an unusual result, but is supported by other interactive results. The result with Uchg and sequential capital level dummies suggests, as capital level increases, IRR decreases in detrimental effect. Then for the two highest capital levels IRR becomes an increasing beneficial factor. This may imply a cause effect relationship between capital and IRR that would provide support for risk based capital standards. Alternatively, the correlation between capital and IRR may be driven by a common third variable. The only presented theory consistent with this result is that capital is a proxy for management ability. Higher capital levels imply better risk management skills.

The interactive term between Uchg and the dummies for total assets shows an increasing sensitivity to IRR as size increases. This is not explained by any theory presented in this research, but there is a plausible explanation. Usually, regulators exercise greater forbearance with large firms because of the extra costs resolution will incur. This sample period is characterized by a large number of failures that were insolvent for several years. It may be that the large firms were backlogged and then failed during this sample period. In other regressions, size is shown positively correlated to thrift failure which supports this idea.

A final interactive term between capital and IRR dummies shows that as IRR increases, sensitivity to capital level decreases when capital level is measured by net worth / total assets. This supports the contention of Cole et al. (1993) that higher IRR leads to inflated book value measures of capital level and would make the stated capital level less significant in preventing failure.

There are several implications of these results for risk based capital regulation. First, the significance of multiple IRR proxies in measuring IRR suggests capital standards may depend on a function of several IRR proxies. Second, variable sensitivity to IRR over asset size may be a sample period bias, but if not, larger firms should have higher capital standards for the same amount of IRR as smaller firms. Finally, the unusual beneficial aspect of IRR for high capital firms conversely suggests that low IRR is detrimental for high capital firms. This implies that risk based capital should require more capital for firms with high IRR and more IRR for firms with high capital.

These results suggest additional research in the area of optimal firm risk levels. For highly capitalized firms, low IRR is positively associated with failure. This may indicate the firm risk level is too low to make adequate profits. Including all types of thrift risk: capital risk, IRR, asset risk, and others, in a single variable may provide information on whether risk is definitively bad or if some amount of risk is optimal. Over time DIs have failed at very different rates, suggesting macroeconomic factors influencing failure rates. These macroeconomic factors may influence the optimal risk level. The relationship between macroeconomic factors and firm specific factors needs to be determined. To gain a more detailed understanding of this relationship, a continuous dependent variable such as net income may be more effective than the binary variable, failure.

The two-index model uses a market and an interest rate index to show a correlation between DI stock return and interest rate changes. Past studies with this methodology have shown support for this relationship. In this study, using thrift stock returns and various interest rate indices, the relationship between stock returns and interest rate changes is not confirmed. This is contradictory to previous studies and to the results of the failure prediction test in this study. The most probable explanation for this unusual result is the lack of volatility in interest rates during the sample period. Also, the interest rates are at moderate levels which reduces their impact on firm value.

The intent of this study is to evaluate IRR proxies. This study shows all the IRR proxies tested to be good measures of actual risk. The MVM, a more technical and theoretically superior measure, showed moderate improvement over simple balance sheet ratios. Finally, the sensitivity of failure to IRR is shown to vary over other firm characteristics, such as capital level and asset size.

APPENDIX

Appendix: (Equations are from the OTS MVM except where noted.)

Prepayment rate-

Prepayment Equation:

$$cpr_{n,t} = seasoning_t * seasonality_t * refinancing_{n,t} \quad (A.1)$$

n - path index, t - month index

Seasoning depends on the age or time since issue of the mortgage. It assumes new mortgages have a slower prepayment rate.

$$seasoning = t / 30 \quad \text{for } t < 30 \text{ months} \quad (A.2)$$

$$1 \quad \text{for } t \geq 30 \text{ months}$$

Seasonality depends on the month of the year (month = 12) and the number of months into the simulation.

$$seasonality = 1+.2000*Sin\{1.571*[(month+t-3)/3]-1\} \quad (A.3)$$

Refinancing depends on the coupon of the mortgage and the simulated mortgage rate. The refinancing equation is security specific and listed following the appropriate security.

The annual prepayment rate is converted to monthly form.

$$p_{n,t} = 1-(1-cpr_{n,t})^{1/12} \quad (A.4)$$

$p_{n,t}$ - monthly prepayment rate; $cpr_{n,t}$- constant prepayment rate- annualized

Fixed Rate Mortgages (FRM) - (Refinancing equations are from the OTS NPVM)

Representative Instrument: FNMA 30 yr. FRM Conventional, seasoned (over 60 months) and moderately seasoned (30 to 60 months)

Data Source: Bloomberg System

Refinancing Equations: well seasoned (over 10 years old)

$$\text{refinancing} = .1828 - .0892 * \arctan[4.776 * (1.083 - \text{coupon/mort})] \quad (A.5)$$

moderately seasoned (less than 10 years old)

$$\text{refinancing} = .1992 - .1295 * \arctan[3.623 * (1.087 - \text{coupon/mort})] \quad (A.6)$$

mort- mortgage rate = short rate at t+60 months

Adjustable Rate Mortgages (ARM)-

Representative Instrument: 1 year reset - 1 year Treasury FNMA

Data Source: Wall Street Journal

Refinancing Equation:

$$\text{refinancing} = .2006 - .0950 * \arctan[2.401 * (1.021 * \text{coupon/mort})] \quad (A.7)$$

Calculation of fully indexed rate:

$$\text{fully indexed rate}_{n,t} = \text{margin} + \text{index}_{j,n,t-2} \quad (A.8)$$

j - adjustable rate index

Projected index:

$$\text{index}_{j,n,t} = \text{forecasted rate}_{n,t} + \text{basis}_j \quad (A.9)$$

$$\text{basis}_j = (\text{mortgage rate (5 year)} - \text{short rate (1 month)}) * M_j \quad (A.10)$$

M_j - .5, .7, and 1 for 1, 3, and 5 year indexes respectively

Calculation of new coupon:

$$c_{n,t} = \max\{[\min(\text{fully indexed rate}, c_{n,t-1} + \text{period cap}, \text{life cap})], c_{n,t-1} - \text{period floor}, \text{life floor}\} \quad (A.11)$$

Assume the first resetting of the coupon occurs at half the reset period, ex: 1 yr. Treasury resets after the 6th month. Index and reset are equal, ex: 5 yr. index resets every 5 years.

Balloon Payment Mortgages

Representative Instrument: FNMA 30 year FRM Conventional; seasoned and moderately seasoned

Data Source: Bloomberg System

Refinancing Equation:

same as FRM

Assume balloon mortgages amortize according to a 30 year schedule. Remaining balance is paid at actual maturity (7.5, 15, or 25 yrs).

Borrowings

Cash Flow (CF) Equation:

$$CF_t = -r\frac{(B_t + B_{t-1})}{2} + (B_t - B_{t-1}) \quad \text{(A.12)}$$

B_t - balance at time t: r - reported cost of funds

$B_t = B_{t-1}$ except $B_{maturity} = 0$

Retail and Wholesale Certificates of Deposit

Next period's balance:

$$B_t = B_{t-1}(1 + r_t) \quad \text{(A.13)}$$

r_t- reported cost of funds

Non-interest cash flows:

$$CF_t = -n\frac{(B_t + B_{t-1})}{2} \tag{A.14}$$

n - noninterest costs

Early withdrawal condition:

$$r * m\langle\left(1+\left(\frac{CD - NOM}{12}\right)\right)^{12m} - 1 \tag{A.15}$$

r - one month interest rate; CD - current CD rate; NOM - contracted CD rate; and

m - years remaining on the CD contract.

Core Deposits

Cash Flow Equation:

$$CF_t = -(r_t + n)\left(\frac{B_t + B_{t-1}}{2}\right) + (B_t - B_{t-1}) \tag{A.16}$$

r_t - reported cost of funds; n - noninterest costs

Next period's balance:

$$B_t = B_{t-1}\left\{\frac{e^q + (r_{t-1} - r_0)(e^q + 1)}{r_0 + 2}\right\} \tag{A.17}$$

q - attrition parameter; r_0- average core deposit for the sample period

Future deposit rates:

$$r_t = r_{t-1} + c(r_{t-1} - r_{t-2}) + d(R_t - R_{t-1}) + e(R_{t-1} - R_{t-2}) + [fH_{t-1} + g(1 - H_{t-1})]E_{t-1} + [jH_{t-2} + k(1 - H_{t-2})]E_{t-2}$$

(A.18)

R_t - reference wholesale CD rate in month t; E_{t-1} - amount by which r_{t-1} deviates from its long-run equilibrium level; H_{t-1} - a number between 0 and 1; c, d, e, f, g, j, & k - regression coefficients estimated from historic data.

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Table 1 - Summary of major legislation affecting thrifts.

Depository Institutions Deregulation and Monetary Control Act- DIDMCA (March 1980)

Phased out Regulation Q over a six-year period ending on March 31, 1986.
Increased federal insurance of accounts from $40 thousand to $100 thousand.
Authorized NOW accounts for individuals and not-for -profit organizations at all federally insured depositories as of December 31, 1980.
Authorized federally chartered S&L's to offer credit-card services and to exercise trust and fiduciary powers.
Authorized federal S&L's to invest up to 20 percent of their assets in a combination of consumer loans, commercial paper, and corporate debt securities, and to invest up to 3 percent of their assets in service corporations, provided that one-half of the investment exceeding 1 percent is allocated to investments that serve primarily community for inner city development purposed.
Expanded the authority of federal S&Ls to make real estate loans by removing geographical lending restrictions. Provided for a 90 percent loan- to value limit in place of the previous $75 thousand limit. Removed the first-lien restriction on residential real estate loans.
Preempted state usury ceilings for residential real estate and certain other loans.
Authorized S&Ls to issue mutual capital certificates to be included in the general reserve and net worth of the issuing institution.

Garn-St. Germain Depository Institutions Act (December 1982)
Provided for broader capital assistance programs.
Expanded the powers of federal insurers in dealing with troubled institutions.
Required the Depository Institutions Deregulation Committee to create a deposit account that would be competitive with money market mutual funds.
Preempted state laws that restricted the enforcement of due-on-sale clauses.
Permitted federal associations to accept demand accounts in connection with a business relationship
Expanded considerably the asset powers of federal associations, including increasing the statutory limit on commercial mortgage loans and consumer loans to 40 percent and 30 percent of assets, respectively. Permitted commercial loans and leases to 10 percent of assets each.

Tax Reform Act (October 1986)
Reduced the deductible contribution to bad-debt reserves to 8 percent of taxable income (down from 40 percent).
Replaced the minimum corporate tax.
Lowered the corporate tax rate so that the maximum rate would be 34 percent down from 46 percent).
Included special rules governing the carryover of net operating losses of a troubled thrift by its acquirer.
Reduced the depreciation benefits of commercial and residential property.

Table 1 (cont'd)

Limited the offsetting losses on passive investments that affect limited partnership syndications and eliminated favorable capital gains treatment.
Provided for three-year carrybacks and 15-year carryforwards for S&Ls net operating losses.

Competitive Equality Banking Act (CEBA) (August 1987)
Provided a funding plan to assist the FSLIC. Under this plan, the Bank Board is to charter a Financing Corporation that would be authorized to borrow up to $10.825 billion (no more than $3.75 billion per year) by issuing long-term bonds to the public. The Financing Corporation is to place the funds it raises with the FSLIC in exchange for nonvoting capital stock and capital certificates. The financing Corporation would be capitalized with the retained earnings of the FHLBanks. Most of these earnings will b invested in deep-discount government bonds that at maturity would provide for the repayment of the principal of the Financing Corporation's bonds. Interest payments on the Financing Corporation's bonds would be net form insurance premiums assessed on FSLIC-insured thrift institutions.
Blocked any thrift institution from leaving the FSLIC for one year. After one year, any institution that exits the fund is to be charged an exit fee of 5/6 of 1 percent of total deposits.
Provided for the phase-out of the FSLIC special assessment, unless the Bank Board determines that extreme pressure continues to exist.
Mandated the Bank Board to prescribe capital recovery regulations (forbearance provisions) for troubled but well-managed and viable institutions in a manner that will maximize the long-term viability of the thrift industry at the lowest cost to the FSLIC. Provided forbearance to institutions with capital of 1/2 of 1 percent of more, provided that their problems are caused by economic adversity beyond their control.
Required that a new appraisal standard for real estate be established that is consistent with the practices of the federal banking agencies.
Required all ARMs on single-family to four-family dwelling units to include an interest rate cap.
Established a new qualified thrift lender test that requires that an insured institution must maintain 60 percent of its tangible assets in housing and housing-related investments in order for the institution to have Qualified Thrift Lender status.
Reduced the eligibility for FHLBank advances for institutions that do not have Qualified Thrift Lender status.
Provided that the current exemption from the nonthrift activity restrictions for unitary S&L holding companies is available to acquiring firms only when the subsidiary thrift has Qualified Thrift Lender status.

Source: Barth et al. (1989)

Table 1 (cont'd)

Financial Institutions Reform, Recovery, and Enforcement Act- FIRREA (1989)
Summarized Congressional intentions to strengthen the thrift industry through improved supervision and stricter regulatory standards, to place the FDIC on sound financial footing, and to promote a safe and stable system of affordable housing finance.
Designated the FDIC as the sole federal deposit insurer for banks and thrifts; restricted thrifts' junk bond and real estate investments; gave FDIC increased authority over state-chartered thrifts.
Created the OTS under the Department of the Treasury as the new principal thrift regulator; required thrift institutions to adhere to capital standards "no less stringent" than those of national banks; increased enforcement powers of FDIC and OTS over insolvent or potentially insolvent institutions; mandated uniform accounting rules for banks and thrifts; increased percentage of mortgage assets thrifts must hold to avoid stricter regulations.
Abolished FSLIC and FHLBB and transferred their regulatory functions to other agencies.
Created the Resolution Trust Corporation, the Resolution Funding Corporation, and the Oversight Board to dispose of insolvent thrifts.
Permitted BHCs to acquire healthy thrifts.
Created the Federal Housing Finance Board to oversee the 12 district FHL Banks; required the FHL Banks to promote "affordable housing" and community investment programs; removed all thrift supervisory authority from the FHL Banks.
Clarified procedures related to bank conservatorships.
Stiffened penalties for depository institution managers and directors who commit fraudulent acts.
Mandated studies on federal deposit insurance, cost and availability of retail banking services, and capital adequacy of government-sponsored organizations.
Required regulators to develop and enforce minimum standards for property appraisal.
Addressed community reinvestment, CUs, consumer protection, and other matters.
Permitted state agencies to buy mortgage-related assets from the Resolution Trust Corporation or FDIC.
Lowered tax benefits to acquirers of failed or failing thrifts.

Federal Deposit Insurance Corporation Improvement Act- FDICIA (1991)
Increased the borrowing authority of the FDIC; established minimum level for the FDIC's reserves; mandated specific examination schedules for depositories and created "tripwire" system for detecting problem institutions" strengthened financial reporting rules for insured firms, including use of generally accepted accounting principles, market valuation of assets and liabilities, and complete analysis of contingent obligations; required regulators to take prompt corrective action against unsound firms; insisted that regulators resolve institution failures in the least costly manner.

Table 1 (cont'd)

Strengthened Fed's authority over expansion or termination of foreign banking operations in the United States; required foreign banks accepting small deposits in the United States to obtain federal deposit insurance; reduced deposit insurance premiums to institutions offering low-cost checking accounts to consumers; encouraged institutions' involvement in "distressed" communities; imposed uniform disclosure of deposit account rates and fee schedules.
Limited institutions' ability to take excessive risks in attracting new deposits; mandated risk-based federal deposit insurance premiums, effective no later than January 1, 1994; unless federal regulators approve, restricted the activities of state chartered banks to those permitted to federally chartered banks; required periodic review of regulators' minimum capital standards.
Different technical policies relating to interbank funds transfers, rights to financial privacy, the QTL test for thrifts, discount window borrowing, and real estate appraisal.
Changed rules under which merged institutions obtain federal deposit insurance.

Source: Gardner and Mills (1994)

Table 2 - Summary of the failure prediction literature.

Paper	Data	Statistical Method	Predicted Variable
Sinkey (75)	Call- (Banks)	QDA	Problem
Altman (77)	Call- (S&L)	QDA	Problem-2
Martin (77)	Call- (Banks)	Logit	Failure
Sinkey (78)	Call & Exam.- (Banks)	DA	Problem
Pettway & Sinkey (80)	Call & Market- (Banks)	MDA & Market Model	Failure
Pettway (80)	Market (Banks)	Modified FFJR	Failure
Schick (80)	Exam. & Market (Banks)	FFJR	Rating Stock Price Decrease
Collins (82)	(Credit Unions)	Linear, MDA, & Logit	Failure
Bovenzi (83)	Call & Exam.- (Banks)	Probit	Failure
Korobow & Stuhr (83)	Call (Banks)		Failure
Richardson (83)	AMEX Firms	LDA	Bankruptcy
Barth etal (85a)	Call (S&L)	Logit	Failure
Rose (85)	Call (Banks)	Univariate & MDA	Failure
West (85)	Call & Exam.- (Banks)	Factor Analysis & Logit	Problem
Lane (86)	Call (Banks)	Cox Hazard	Failure & Time to Failure
Pantalone & Platt (87)	Call (S&L)- Boston	LDA	Failure
Pantalone & Platt (87)	Call (Banks)	Logit	Failure
Elmer (88)	Call (S&L)	Expert Systems	Failure
Looney (89)	Call (Banks)	Cox, MDA(linear & quadratic)	Misclassification
Barth et al. (90)	Call (S&L)	OLS, Tobit	Resolution Costs
James (91)	Call (Banks)	WLS	Loss on Failure
Salchenberger (92)	Call (S&L)	Neural Networks	Failure
Thomson (92)	Call (Banks)	Two-step Logit	Closure
Cole (93)	Call (S&L)	Bivariate Probit	Insolvency/Closure

Table 3 - Summary of the literature on financial institutions in two-index models.

Paper	B_m	B_I	Period	Obs.	Firms	Firm type	R^2	IRR	Model
Lynge (80)	.79*	-.002	69-72	mthly	57	banks	.25		2-index
	.88*	-.002*	69-75	mthly	57	banks	.27		2-index
Chance (80)	1.04*	-.003*	72-76		119		.35		2-index
Booth (85)	.93*	-.002*	66-80	mthly	66	banks	.34		2-index
Scott (86)	.67*	-.40*	77-84	mthly	78	banks	.62		2-index
	1.35*	-.84*	77-84	mthly	8	S&L	.51		2-index
Kane (88)	.07- 1.4*	.2-.45* GNMA	75-85	mthly		Money- Center			Goldfeld- Quandt
	.45*- 1.37*	-.26- .54*	75-85	mthly		Super- Regional			
	.43*- 1.33*	.27*- .43	75-85	mthly		Regional bank			
	-1.12*- 2.67*	.43- 3.02*	75-85	mthly		S&Ls			
Yourougou (90)	.78* G3	-.03*	77-79	weekly	83 32	Banks S&Ls			APT
	.60*	-.02*	79-81	weekly					
Flannery (84)	.56*	.13* GNMA	76-81	weekly	67	Banks	.57	.143* -.03*	2-index 2-stage
	.56*	.069* G7	76-81	weekly	67	Banks	.56	.054* -.02*	
	.56*	.52* TB	76-81	weekly	67	Banks	.57	.54* -.12*	
	1.11*	.47* GNMA	76-81	weekly	26	S&Ls	.50		2-index
	1.08*	.32* G7	76-81	weekly	26	S&Ls	.49		
	1.09*	2.02* TB	76-81	weekly	26	S&Ls	.50		
James (86)		.835* GNMA	76-82	weekly	30	S&Ls	.15	-1.5*	1-index 2-stage
Tarhan (87) lg gap port.	.39*	-.002* 3-mth	79-82	mthly	46	Banks		.002*	2-index 2-stage
	.45*	-.002*	79-82	mthly	46	Banks		- .002*	
sm. gap port.	.51*	-.002*	79-82	mthly	46	Banks		- .002*	
Kwan (91)	##	8@10% short	76-82	mthly	51	Banks		-1.7*	SUR
	##	24@10% long	76-82	mthly	51	Banks		.004	

* - significant at the 10% level.

Table 4 - MVM Methodologies Chart

Security Type	Discount Method	Discount Rate	Cash Flow	Embedded Options
Assets				
Fixed Rate Mortgages	OAS	200 paths + OAS	Monthly Amortized Payment + Prepayment	Prepayment
Adjustable Rate Mortgages	OAS	200 paths + OAS	Monthly Amortized Payment + Prepayment	Prepayment + Caps
Balloon Rate Mortgages	OAS	200 paths + OAS	Monthly Amortized Payment + Prepayment	Prepayment
Other Mortgages	DCF	0-Coupon Treasury + Spread	Monthly Amortized Payment + Prepayment. 1st Two Buckets at Adjustable Rate	
Second Mortgages	DCF	0-Coupon Treasury + Spread	Monthly Amortized Payment + Prepayment: 1st Two Buckets at Adjustable Rate	
Consumer Loans	DCF	0-Coupon Treasury + Spread	Monthly Interest Payment: 1st Bucket at Adjustable Rate	
Commercial Loans	DCF	0-Coupon Treasury + Spread	Monthly Interest Payment: 1st Bucket at Adjustable Rate	
Investment Securities	DCF	0-Coupon Treasury	Semi-Annual Interest Payment	
Liabilities				
Other Borrowings	DCF	Wholesale CD Yields	Interest Payments	
FHLB Advances	DCF	Wholesale CD Yields	Interest Payments	
Fixed Maturity Deposits	DCF	Wholesale CD Yields	Non-interest + Early Withdrawal +Balance at Maturity	
Core Deposits	DCF	Wholesale CD Yields	Monthly Transactions + Principal at 25 years	

Table 5- Price sensitivity table on December 31,1985 for fixed rate Federal National Mortgage Association (FNMA) mortgages.

Current term structure

	Coupon							
Maturity	0.07	0.08	0.09	0.1	0.11	0.12	0.13	0.14
25	0.87798	0.91587	0.96157	1.00459	1.03259	1.04965	1.05279	1.06128
15	0.90280	0.92922	0.96690	1.00608	1.03345	1.05131	1.05532	1.06512
7.5	0.93929	0.95537	0.98123	1.00995	1.03089	1.04514	1.04864	1.05693
4	0.96688	0.97616	0.99254	1.01163	1.02603	1.03616	1.03888	1.04508

Term structure shock - up 200 bp

	Coupon							
Maturity	0.07	0.08	0.09	0.1	0.11	0.12	0.13	0.14
25	0.77600	0.81661	0.87225	0.93015	0.97152	0.99809	1.00668	1.019364
15	0.82639	0.85213	0.89339	0.94028	0.97562	0.99957	1.00737	1.019984
7.5	0.88661	0.90241	0.92992	0.96234	0.98725	1.00464	1.01015	1.019975
4	0.93344	0.94270	0.95978	0.98039	0.99643	1.00788	1.01144	1.01828

Term structure shock - down 200 bp

	Coupon							
Maturity	0.07	0.08	0.09	0.1	0.11	0.12	0.13	0.14
25	0.97572	0.99687	1.02569	1.05571	1.07627	1.08947	1.09099	1.09819
15	0.98065	0.99868	1.02673	1.05806	1.08087	1.09641	1.09925	1.10828
7.5	0.99218	1.00446	1.02565	1.05038	1.06893	1.08197	1.08488	1.09283
4	1.00014	1.00791	1.02239	1.03984	1.05326	1.06292	1.06541	1.07150

Term structure shock - actual term structure change

	Coupon							
Maturity	0.07	0.08	0.09	0.1	0.11	0.12	0.13	0.14
25	0.97656	0.99681	1.02517	1.05494	1.07531	1.08834	1.08968	1.09675
15	0.98081	0.99833	1.02611	1.05728	1.07994	1.09533	1.09802	1.10695
7.5	0.99080	1.00296	1.02412	1.04883	1.06733	1.08028	1.08311	1.09099
4	0.99777	1.00558	1.02013	1.03762	1.05103	1.06066	1.06311	1.06917

Key: Prices are differentiated by term structure, coupon, and maturity.

Table 6 - Failure Record for Thrifts in months 1 through 12.

Year	Thrifts at the beginning of the year	Receivership (from months 0 to 12)	Conservatorship[1] (from months 0 to 12)	Total Failures (from months 0 to 12)
1986	3135	45	9	54
1987	3164	40	23	62[2]
1988	3085	179	6	185
1989	2864	282	0	282
1990	2648	187	3	190
Total	14896	733	41	773

Key: The failure data is compiled from lists provided by the Office of Thrift Supervision and the Federal Deposit Insurance Corporation. Receivership implies a regulatory change of ownership while conservatorship implies a regulatory change of management. Total failures is the sum of both receivership and conservatorship. The number of thrifts is from the Thrift Financial Report of the previous December.

1 This includes management consignment programs and other conservator-like programs.

2 One firm enters conservatorship and receivership in the same year.

Table 7 - Failure Record for Thrifts in months 13 through 24.

Year	Thrifts at the beginning of the year	Receivership (from months 13 to 24)	Conservatorship[1] (from months 13 to 24)	Total Failures (from months 13 to 24)
1986	3135	40	23	62[2]
1987	3164	197	6	203
1988	3085	291	0	291
1989	2864	191	2	193
1990	2648	134	8	142
Total	14896	853	39	891

Key: The failure data is compiled from lists provided by the Office of Thrift Supervision and the Federal Deposit Insurance Corporation. Receivership implies a regulatory change of ownership while conservatorship implies a regulatory change of management. Total failures is the sum of both receivership and conservatorship. The number of thrifts is from the Thrift Financial Report of the previous December.

1 This includes management consignment programs and other conservator-like programs.

2 One firm enters conservatorship and receivership in the same year.

Table 8 - Summary Statistics:

	Median	Mean	Standard Deviation
Total Assets- (*1,000)	$99,846	$400,151	$1,436,107
Capital- (net worth/ttl asts)	0.0520	0.0443	0.0807
Capital- (MVPE/market)	0.0603	0.0406	0.1070
Capital- (MVPE/ttl asts)	0.0596	0.0439	0.0930
Capital- exp(net worth/ttl asts)	1.0534	1.0484	0.0735
Asset Quality- (repos'd asts/ttl asts)	0.0034	0.0159	0.0404
Asset Quality- (other real estate/ttl asts)	0.0000	0.0034	0.0163
Management Efficiency- (net inc/gr inc)	0.0203	0.0228	0.0124
Earnings Ability- (net inc/ttl asts)	0.0012	-0.0015	0.0159
Earnings Ability- (int inc/int exp)	1.1200	12.0307	434.8286
Liquidity- (amt elig for reg liq/ttl asts)	0.1005	0.1303	0.0972
Liquidity- (brokered deposits/ttl asts)	0.0000	0.0138	0.0511
Liquidity- (cash and securities/ttl asts)	0.0371	0.0562	0.0625
Uchg- (MVPE-MVPE$_u$)/Market Asts	0.0296	0.0301	0.0123
ISF- (interest sensitive funds/ttl funds)	0.9278	0.9046	0.0851
SHORT- (s.t. liab's - s.t. asts)/ttl asts	0.1175	0.1282	0.2519
Interactive Variables			
Uchg*exp(capital)	0.0309	0.0314	0.0122
ISF*exp(capital)	0.9653	0.9433	0.1314
SHORT*exp(capital)	0.1218	0.1232	0.2014

Key: The accounting and maturity data are from, December 31, Thrift Financial Reports (TFRs), 1985-1989. There are 14,896 observations with data for each variable.

Table 9 - Logit regression of year one failures onto base CAMEL and IRR variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.923 (-16.875)	-3.357 (-4.730)	-3.597 (-7.184)	-2.826 (-7.317)	-1.880 (-3.408)	-2.294 (-7.183)
Capital- (net worth/ttl asts)	-6.774 (-12.137)	-24.795 (-7.406)	-7.088 (-5.339)	-8.216 (-7.304)	-49.648 (-11.648)	1.421 (1.218)
Asset Quality- (repos'd asts/ttl asts)	4.007 (4.608)	1.215 (0.268)	2.706 (1.124)	4.830 (3.211)	9.773 (3.280)	2.798 (1.437)
Management Efficiency- (non-int exp/ttl asts)	3.262 (1.122)	23.460 (2.617)	3.966 (0.733)	-13.696 (-2.040)	3.122 (0.284)	9.818 (1.763)
Earnings Ability- (net inc/ttl asts)	-22.681 (-8.811)	26.270 (2.908)	-13.764 (-3.186)	-13.379 (-2.943)	-30.255 (-2.399)	-51.129 (-6.569)
Liquidity- (amt elig for reg liq/ttl asts)	-8.232 (-9.802)	-2.995 (-1.233)	-2.022 (-1.073)	-2.344 (-1.799)	-5.594 (-2.106)	-14.956 (-6.930)
Uchg- $(MVPE-MVPE_u)/$ Market Asts	17.915 (5.000)	-15.253 (-0.840)	-15.879 (-1.023)	9.873 (1.301)	17.944 (1.880)	17.920 (2.471)
AIC	4431	394	476	1020	611	1146
LRI	0.273	0.303	0.243	0.281	0.676	0.172

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 10 - Logit regression of year two failures onto base CAMEL and IRR variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.395 (-14.874)	-1.302 (-2.110)	-1.738 (-4.964)	-1.247 (-3.180)	-2.082 (-5.351)	-2.594 (-7.782)
Capital- (net worth/ttl asts)	-4.731 (-7.255)	-17.123 (-4.841)	-10.933 (-6.605)	-16.509 (-7.792)	-30.749 (-8.448)	-1.757 (-1.459)
Asset Quality- (repos'd asts/ttl asts)	10.551 (10.318)	4.645 (1.220)	7.367 (3.428)	24.343 (8.325)	20.438 (6.762)	3.218 (1.531)
Management Efficiency- (non-int exp/ttl asts)	11.289 (3.751)	10.500 (1.050)	-4.662 (-0.671)	-7.346 (-0.880)	24.990 (3.762)	14.264 (2.338)
Earnings Ability- (net inc/ttl asts)	-13.020 (-3.832)	16.076 (1.689)	-12.853 (-1.946)	-13.471 (-1.644)	6.507 (0.533)	18.685 (1.803)
Liquidity- (amt elig for reg liq/ttl asts)	-8.297 (-11.617)	-12.216 (-3.891)	-6.969 (-4.990)	-8.308 (-5.299)	-4.304 (-2.723)	-5.820 (-3.681)
Uchg- $(MVPE-MVPE_u)/$ Market Asts	6.641 (2.011)	-40.336 (-2.593)	0.567 (0.067)	-0.102 (-0.015)	18.154 (2.539)	3.819 (0.460)
AIC	5478	490	1102	1205	1102	1058
LRI	0.168	0.185	0.245	0.368	0.207	0.038

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 11 - Logit regression of year one failures onto base CAMEL and Dchg variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.685	-3.604	-3.917	-2.967	-1.584	-2.048
	(-17.874)	(-5.334)	(-8.595)	(-9.396)	(-3.401)	(-7.149)
Capital-	-6.784	-24.874	-7.062	-8.199	-50.032	1.466
(net worth/ttl asts)	(-12.170)	(-7.449)	(-5.290)	(-7.312)	(-11.740)	(1.272)
Asset	3.983	1.024	1.954	4.114	9.358	3.233
Quality- (repos'd asts/ttl asts)	(4.547)	(0.224)	(0.818)	(2.709)	(3.132)	(1.675)
Management	2.627	24.939	4.733	-13.451	1.912	9.682
Efficiency- (non-int exp/ttl asts)	(0.907)	(2.860)	(0.866)	(-2.040)	(0.172)	(1.732)
Earnings	-22.355	26.081	-13.588	-13.484	-29.133	-50.803
Ability- (net inc/ttl asts)	(-8.690)	(2.894)	(-3.137)	(-2.903)	(-2.314)	(-6.556)
Liquidity-	-8.299	-3.052	-2.017	-2.289	-5.639	-14.811
(amt elig for reg liq/ttl asts)	(-9.896)	(-1.246)	(-1.063)	(-1.755)	(-2.129)	(-6.879)
Dchg-	13.199	-8.747	-2.959	16.312	13.694	10.810
($MVPE_d$-MVPE)/ Market Asts	(4.172)	(-0.467)	(-0.227)	(2.733)	(1.696)	(1.680)
AIC	4438	395	477	1015	611	1150
LRI	0.272	0.302	0.241	0.285	0.676	0.169

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 12 - Logit regression of year two failures onto base CAMEL and Dchg variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.618 (-18.321)	-2.345 (-3.783)	-1.991 (-6.304)	-1.668 (-4.934)	-2.092 (-6.651)	-2.751 (-9.169)
Capital- (net worth/ttl asts)	-4.699 (-7.196)	-16.763 (-4.842)	-10.869 (-6.596)	-16.284 (-7.712)	-30.708 (-8.399)	-1.768 (-1.478)
Asset Quality- (repos'd asts/ttl asts)	9.854 (9.586)	3.259 (0.855)	6.673 (3.105)	23.449 (7.966)	19.704 (6.496)	2.629 (1.264)
Management Efficiency- (non-int exp/ttl asts)	12.335 (4.098)	17.220 (1.807)	-3.685 (-0.528)	-5.120 (-0.623)	24.639 (3.759)	14.456 (2.371)
Earnings Ability- (net inc/ttl asts)	-12.635 (-3.709)	14.881 (1.602)	-12.573 (-1.904)	-14.753 (-1.727)	7.800 (0.638)	18.757 (1.825)
Liquidity- (amt elig for reg liq/ttl asts)	-8.229 (-11.517)	-12.752 (-4.004)	-6.882 (-4.921)	-8.178 (-5.228)	-4.597 (-2.869)	-5.730 (-3.615)
Dchg- $(MVPE_\sigma$-MVPE)/ Market Asts	15.410 (5.460)	-8.458 (-0.518)	10.467 (1.627)	12.090 (2.240)	23.980 (4.208)	11.823 (1.683)
AIC	5455	496	1099	1200	1092	1055
LRI	0.172	0.174	0.246	0.371	0.215	0.040

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 13 - Logit regression of year one failures onto base CAMEL and Achg variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.482 (-20.327)	-3.880 (-6.422)	-3.822 (-9.781)	-1.878 (-5.437)	N.C.	-1.530 (-5.710)
Capital- (net worth/ttl asts)	-6.894 (-12.177)	-24.776 (-7.447)	-7.161 (-5.353)	-7.890 (-6.990)		1.744 (1.540)
Asset Quality- (repos'd asts/ttl asts)	5.107 (5.976)	0.486 (0.107)	0.868 (0.351)	5.989 (3.978)		3.284 (1.756)
Management Efficiency- (non-int exp/ttl asts)	1.488 (0.522)	26.011 (2.993)	3.734 (0.667)	-14.258 (-2.143		8.105 (1.431)
Earnings Ability- (net inc/ttl asts)	-22.466 (-8.773)	25.790 (2.860)	-13.753 (-3.189)	-12.804 (-2.714)		-50.953 (-6.536)
Liquidity- (amt elig for reg liq/ttl asts)	-8.040 (-9.641)	-3.007 (-1.226)	-1.898 (-1.005)	-2.291 (-1.795)		-15.015 (-6.960)
Achg- (MVPE-MVPE$_0$)/ Market Asts	2.439 (6.544)	-0.633 (-0.038)	-12.803 (-0.813)	-23.082 (-2.299)		8.612 (2.992)
AIC	4416	395	477	1016		1144
LRI	0.276	0.302	0.242	0.284		0.173

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

N.C. - no convergence.

Table 14 - Logit regression of year two failures onto base CAMEL and Achg variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.234	-2.469	-1.621	-0.640	-0.540	-2.093
	(-19.242)	(-4.378)	(-5.538)	(-1.813)	(-1.624)	(-7.521)
Capital-	-5.011	-16.677	-11.071	-15.726	-31.401	-1.311
(net worth/ttl asts)	(-7.538)	(-4.830)	(-6.647)	(-7.378)	(-8.533)	(-1.091)
Asset	10.951	3.029	6.810	24.313	18.733	2.688
Quality- (repos'd asts/ttl asts)	(10.777)	(0.802)	(3.063)	(8.266)	(6.029)	(1.341)
Management	9.905	17.745	-5.688	-7.699	23.900	11.501
Efficiency- (non-int exp/ttl asts)	(3.288)	(1.868)	(-0.817)	(-0.955)	(3.639)	(1.823)
Earnings	-13.102	14.700	-12.952	-18.351	10.827	16.374
Ability- (net inc/ttl asts)	(-3.851)	(1.587)	(-1.959)	(-1.881)	(0.881)	(1.555)
Liquidity-	-8.163	-12.766	-6.886	-7.830	-3.998	-6.302
(amt elig for reg liq/ttl asts)	(-11.471)	(-4.005)	(-4.925)	(-5.055)	(-2.662)	(-3.987)
Achg-	1.409	4.728	-7.105	-25.346	-4.032	10.986
(MVPE-MVPE$_a$)/ Market Asts	(4.027)	(0.314)	(-0.785)	(-2.768)	(-3.785)	(3.711)
AIC	5467	496	1101	1196	1092	1044
LRI	0.170	0.174	0.245	0.373	0.214	0.051

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 15 - Logit regression of year one failures onto base CAMEL and ISF variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-3.473 (-6.916)	-3.470 (-2.277)	-5.424 (-3.273)	-6.160 (-4.722)	N.C.	-0.697 (-0.811)
Capital- (net worth/ttl asts)	-6.711 (-12.016)	-24.793 (-7.449)	-7.046 (-5.221)	-8.042 (-7.178)		1.398 (1.211)
Asset Quality- (repos'd asts/ttl asts)	4.811 (5.666)	0.516 (0.116)	1.573 (0.706)	4.804 (3.282)		4.144 (2.202)
Management Efficiency- (non-int exp/ttl asts)	1.773 (0.618)	25.945 (3.070)	4.874 (0.893)	-15.121 (-2.224)		9.427 (1.685)
Earnings Ability- (net inc/ttl asts)	-22.319 (-8.721)	25.645 (2.841)	-13.142 (-3.045)	-13.353 (-2.865)		-51.184 (-6.620)
Liquidity- (amt elig for reg liq/ttl asts)	-8.827 (-10.249)	-2.889 (-1.165)	-2.379 (-1.211)	-3.387 (-2.490)		-14.209 (-6.516)
ISF- (interest sensitive funds/ttl funds)	1.326 (2.377)	-0.458 (-0.266)	1.663 (0.893)	4.200 (2.935)		-1.298 (-1.357)
AIC	4449	395	476	1012		1150
LRI	0.271	0.302	0.242	0.287		0.169

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

N.C.- no convergeance

Table 16 - Logit regression of year two failures onto base CAMEL and ISF variables.

Data Period for Independent Variables

	1985-89	1985	1986	1987	1988	1989
Constant	-1.219 (-3.260)	-0.648 (-0.579)	-2.209 (-2.470)	-0.236 (-0.285)	1.178 (1.456)	-0.775 (-0.838)
Capital- (net worth/ttl asts)	-4.817 (-7.360)	-16.890 (-4.874)	-10.908 (-6.608)	-16.687 (-7.877)	-31.799 (-8.592)	-1.906 (-1.585)
Asset Quality- (repos'd asts/ttl asts)	10.929 (10.800)	2.786 (0.740)	7.320 (3.464)	24.694 (8.417)	21.172 (6.977)	3.564 (1.773)
Management Efficiency- (non-int exp/ttl asts)	10.108 (3.405)	17.969 (1.932)	-4.568 (-0.660)	-7.333 (-0.899)	20.175 (3.098)	14.180 (2.319)
Earnings Ability- (net inc/ttl asts)	-13.261 (-3.926)	13.937 (1.502)	-12.676 (-1.921)	-12.631 (-1.536)	5.219 (0.425)	18.971 (1.806)
Liquidity- (amt elig for reg liq/ttl asts)	-7.995 (-11.111)	-11.682 (-3.647)	-7.150 (-4.975)	-7.920 (-4.997)	-3.262 (-2.106)	-5.234 (-3.334)
ISF- (interest sensitive funds/ttl funds)	-1.096 (-2.655)	-2.322 (-1.841)	0.568 (0.571)	-1.178 (-1.295)	-2.904 (-3.268)	-1.954 (-1.925)
AIC	5476	493	1101	1203	1098	1055
LRI	0.168	0.179	0.245	0.369	0.210	0.041

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 17 - Logit regression of year one failures onto base CAMEL and SHORT variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-2.556	-3.628	-3.793	-2.721	-1.518	-2.219
	(-19.766)	(-8.475)	(-10.699)	(-10.132)	(-3.829)	(-8.253)
Capital-	-5.726	-26.090	-8.230	-7.178	-48.173	3.200
(net worth/ttl asts)	(-9.699)	(-7.455)	(-5.297)	(-6.074)	(-11.370)	(2.608)
Asset	4.355	1.440	2.584	4.520	8.946	2.828
Quality- (repos'd asts/ttl asts)	(5.100)	(0.324)	(1.116)	(3.031)	(3.007)	(1.481)
Management	2.190	25.789	4.883	-13.949	-0.975	10.072
Efficiency- (non-int exp/ttl asts)	(0.769)	(3.066)	(0.918)	(-2.125)	(-0.091)	(1.829)
Earnings	-22.724	27.924	-13.119	-13.810	-30.143	-49.850
Ability- (net inc/ttl asts)	(-8.916)	(3.068)	(-3.020)	(-3.094)	(-2.376)	(-6.484)
Liquidity-	-8.194	-3.182	-2.263	-2.288	-5.197	-14.247
(amt elig for reg liq/ttl asts)	(-9.839)	(-1.293)	(-1.195)	(-1.764)	(-1.972)	(-6.686)
SHORT-	1.198	-1.222	-1.381	1.358	2.063	1.964
(s.t. liab's - s.t. asts)/ttl asts	(4.871)	(-1.327)	(-1.638)	(2.666)	(2.943)	(4.294)
AIC	4431	393	475	1015	605	1134
LRI	0.273	0.305	0.245	0.285	0.679	0.181

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 18 - Logit regression of year two failures onto base CAMEL and SHORT variables.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.254	-2.532	-1.755	-1.548	-1.710	-2.476
	(-18.644)	(-5.992)	(-6.260)	(-5.208)	(-6.239)	(-9.343)
Capital- (net worth/ttl asts)	-4.318	-17.004	-10.731	-15.313	-29.408	-1.820
	(-6.370)	(-4.733)	(-6.126)	(-7.126)	(-8.091)	(-1.447)
Asset Quality- (repos'd asts/ttl asts)	10.587	3.040	7.306	23.973	20.114	3.583
	(10.404)	(0.812)	(3.447)	(8.196)	(6.515)	(1.753)
Management Efficiency- (non-int exp/ttl asts)	10.760	18.346	-4.596	-5.982	23.158	14.199
	(3.631)	(1.993)	(-0.664)	(-0.742)	(3.489)	(2.320)
Earnings Ability- (net inc/ttl asts)	-13.133	15.144	-13.039	-12.932	8.045	18.591
	(-3.908)	(1.611)	(-1.978)	(-1.591)	(0.662)	(1.789)
Liquidity- (amt elig for reg liq/ttl asts)	-8.310	-12.791	-6.951	-8.073	-4.133	-5.842
	(-11.670)	(-4.013)	(-4.978)	(-5.170)	(-2.657)	(-3.692)
SHORT- (s.t. liab's - s.t. asts)/ttl asts	0.455	-0.317	0.180	1.373	1.929	-0.131
	(2.088)	(-0.383)	(0.350)	(2.912)	(3.963)	(-0.269)
AIC	5478	496	1102	1197	1092	1058
LRI	0.168	0.174	0.245	0.373	0.214	0.038

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 19 - Logit regression of year one failures onto base CAMEL and IRR variables except MVPE / market is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-3.390	-3.974	-3.940	-3.538	-3.315	-2.189
	(-21.084)	(-6.055)	(-8.042)	(-10.195)	(-7.462)	(-7.254)
Capital-	-4.336	-5.800	-5.083	-7.035	-21.488	-2.345
(MVPE/market)	(-14.253)	(-4.362)	(-4.587)	(-7.971)	(-12.093)	(-4.889)
Asset	7.159	14.193	7.187	7.991	19.718	-1.538
Quality- (repos'd asts/ttl asts)	(9.758)	(4.516)	(3.615)	(6.072)	(7.547)	(-0.902)
Management	10.713	25.529	9.150	-1.203	21.287	6.677
Efficiency- (non-int exp/ttl asts)	(3.997)	(2.947)	(1.737)	(-0.209)	(2.680)	(1.283)
Earnings	-26.991	-9.521	-17.262	-17.288	-71.932	-38.976
Ability- (net inc/ttl asts)	(-10.833)	(-1.394)	(-4.385)	(-3.998)	(-7.459)	(-5.478)
Liquidity-	-8.245	-4.199	-1.435	-1.575	-5.388	-15.576
(amt elig for reg liq/ttl asts)	(-10.220)	(-1.790)	(-0.792)	(-1.225)	(-2.377)	(-7.335)
Uchg-	20.568	-10.983	-12.943	18.280	14.179	20.189
(MVPE-MVPE$_U$)/ Market Asts	(6.012)	(-0.652)	(-0.844)	(2.698)	(1.666)	(2.832)
AIC	4401	449	489	1002	714	1126
LRI	0.278	0.203	0.221	0.294	0.620	0.187

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 20 - Logit regression of year two failures onto base CAMEL and IRR variables except MVPE / market is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.642 (-17.817)	-1.881 (-3.209)	-2.084 (-6.091)	-2.043 (-5.710)	-2.200 (-6.025)	-2.677 (-8.476)
Capital- (MVPE/market)	-2.727 (-8.688)	-2.411 (-1.931)	-11.312 (-9.189)	-10.472 (-8.005)	-19.087 (-10.785)	-2.199 (-4.176)
Asset Quality- (repos'd asts/ttl asts)	11.829 (12.590)	10.408 (3.245)	9.511 (4.954)	29.128 (10.348)	24.143 (7.643)	1.907 (0.978)
Management Efficiency- (non-int exp/ttl asts)	14.860 (5.376)	15.084 (1.623)	-1.516 (-0.197)	6.285 (0.943)	25.651 (3.777)	15.769 (2.731)
Earnings Ability- (net inc/ttl asts)	-17.602 (-5.630)	-13.395 (-1.823)	-17.817 (-2.799)	-21.921 (-2.636)	-8.049 (-0.718)	20.722 (2.137)
Liquidity- (amt elig for reg liq/ttl asts)	-8.546 (-12.103)	-13.826 (-4.394)	-5.816 (-4.186)	-7.855 (-4.931)	-4.216 (-2.721)	-7.110 (-4.597)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	8.404 (2.631)	-36.323 (-2.388)	5.388 (0.631)	6.017 (0.918)	4.789 (0.659)	4.490 (0.546)
AIC	5465	511	1050	1196	1057	1044
LRI	0.170	0.147	0.280	0.373	0.240	0.051

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 21 - Logit regression of year one failures onto base CAMEL and IRR variables except MVPE / total assets is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-3.223 (-19.795)	-3.939 (-5.999)	-3.835 (-7.776)	-3.097 (-9.216)	-3.223 (-7.193)	-2.097 (-6.972)
Capital- (MVPE/ttl asts)	-6.265 (-15.856)	-9.131 (-5.777)	-5.568 (-4.230)	-9.422 (-9.465)	-23.697 (-12.087)	-3.621 (-5.104)
Asset Quality- (repos'd asts/ttl asts)	6.333 (8.428)	15.072 (5.204)	6.785 (3.354)	7.040 (5.201)	19.700 (7.441)	-2.492 (-1.409)
Management Efficiency- (non-int exp/ttl asts)	7.814 (2.819)	25.169 (2.896)	7.821 (1.438)	-6.894 (-1.088)	21.102 (2.591)	5.093 (0.979)
Earnings Ability- (net inc/ttl asts)	-25.378 (-10.258)	-5.148 (-0.724)	-16.942 (-4.261)	-15.516 (-3.563)	-70.404 (-7.172)	-36.899 (-5.185)
Liquidity- (amt elig for reg liq/ttl asts)	-8.254 (-10.078)	-3.552 (-1.526)	-1.553 (-0.853)	-1.606 (-1.233)	-5.204 (-2.261)	-16.163 (-7.542)
Uchg- ($MVPE-MVPE_u$)/ Market Asts	19.599 (5.669)	-12.001 (-0.711)	-13.428 (-0.876)	13.223 (2.061)	12.897 (1.509)	20.221 (2.847)
AIC	4345	438	490	981	701	1123
LRI	0.288	0.223	0.219	0.309	0.627	0.189

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 22 - Logit regression of year two failures onto base CAMEL and IRR variables except MVPE / total assets is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.555 (-17.012)	-1.848 (-3.161)	-1.987 (-5.808)	-1.860 (-5.280)	-2.135 (-5.850)	-2.593 (-8.155)
Capital- (MVPE/ttl asts)	-4.038 (-9.945)	-3.592 (-2.059)	-12.589 (-9.758)	-12.999 (-9.431)	-20.535 (-11.069)	-3.565 (-4.508)
Asset Quality- (repos'd asts/ttl asts)	11.282 (11.925)	10.318 (3.205)	9.200 (4.784)	28.954 (10.176)	24.533 (7.673)	0.946 (0.462)
Management Efficiency- (non-int exp/ttl asts)	14.163 (4.984)	15.185 (1.632)	-3.332 (-0.432)	5.231 (0.784)	26.214 (3.865)	14.064 (2.363)
Earnings Ability- (net inc/ttl asts)	-15.880 (-5.086)	-12.066 (-1.583)	-15.881 (-2.552)	-19.166 (-2.313)	-6.509 (-0.582)	25.541 (2.481)
Liquidity- (amt elig for reg liq/ttl asts)	-8.515 (-11.982)	-13.569 (-4.297)	-5.787 (-4.145)	-7.653 (-4.741)	-4.116 (-2.658)	-7.577 (-4.758)
Uchg- $(MVPE-MVPE_U)$/ Market Asts	8.073 (2.518)	-36.554 (-2.406)	5.570 (0.651)	4.482 (0.691)	3.800 (0.523)	4.747 (0.579)
AIC	5439	511	1042	1171	1050	1041
LRI	0.174	0.148	0.286	0.386	0.245	0.054

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 23 - Logit regression of year one failures onto base CAMEL and IRR variables except exp (net worth / total assets) is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	7.611 (10.435)	25.006 (6.688)	7.367 (4.157)	9.913 (6.612)	50.278 (10.919)	-1.053 (-0.763)
Capital- exp(net worth/ttl asts)	-10.312 (-15.650)	-28.215 (-7.826)	-10.819 (-6.671)	-12.458 (-9.341)	-52.006 (-11.879)	-1.047 (-0.838)
Asset Quality- (repos'd asts/ttl asts)	2.145 (2.440)	-0.140 (-0.030)	0.766 (0.303)	2.837 (1.871)	9.265 (3.081)	0.575 (0.294)
Management Efficiency- (non-int exp/ttl asts)	-0.313 (-0.108)	22.108 (2.420)	0.875 (0.166)	-19.069 (-2.810)	1.858 (0.165)	6.792 (1.243)
Earnings Ability- (net inc/ttl asts)	-18.646 (-7.334)	27.158 (2.996)	-10.909 (-2.539)	-8.701 (-1.965)	-27.558 (-2.182)	-45.815 (-6.052)
Liquidity- (amt elig for reg liq/ttl asts)	-8.105 (-9.574)	-2.687 (-1.108)	-1.583 (-0.841)	-2.323 (-1.734)	-5.380 (-2.006)	-14.721 (-6.806)
Uchg- $(MVPE-MVPE_u)/$ Market Asts	17.925 (4.948)	-16.985 (-0.928)	-16.165 (-1.028)	10.131 (1.313)	16.909 (1.747)	18.473 (2.559)
AIC	4323	386	460	981	595	1147
LRI	0.291	0.319	0.269	0.309	0.685	0.171

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 24 - Logit regression of year two failures onto base CAMEL and IRR variables except exp (net worth / total assets) is used for capital.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	5.385 (6.561)	18.295 (4.654)	12.929 (6.353)	19.526 (7.866)	29.997 (7.946)	1.391 (0.885)
Capital- exp(net worth/ttl asts)	-7.597 (-10.107)	-19.480 (-5.233)	-14.451 (-7.698)	-20.493 (-8.935)	-31.994 (-8.878)	-3.827 (-2.691)
Asset Quality- (repos'd asts/ttl asts)	9.143 (8.831)	3.809 (0.968)	5.853 (2.687)	22.988 (7.740)	20.149 (6.622)	2.006 (0.943)
Management Efficiency- (non-int exp/ttl asts)	9.369 (2.959)	9.467 (0.938)	-7.166 (-1.065)	-10.298 (-1.192)	24.870 (3.715)	11.589 (1.836)
Earnings Ability- (net inc/ttl asts)	-8.505 (-2.511)	16.532 (1.797)	-9.520 (-1.420)	-7.946 (-0.971)	8.584 (0.699)	24.635 (2.245)
Liquidity- (amt elig for reg liq/ttl asts)	-8.118 (-11.315)	-11.902 (-3.798)	-6.784 (-4.813)	-8.108 (-5.122)	-4.050 (-2.569)	-5.545 (-3.495)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	6.596 (1.986)	-41.497 (-2.657)	-0.411 (-0.048)	-0.804 (-0.120)	17.926 (2.495)	4.182 (0.503)
AIC	5421	485	1080	1177	1089	1053
LRI	0.177	0.193	0.260	0.383	0.216	0.043

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 25 - Logit regression of year one failures onto base CAMEL and IRR variables except other real estate / total assets is used for asset quality.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.861 (-16.662)	-3.344 (-4.711)	-3.653 (-7.198)	-2.774 (-7.083)	-1.521 (-2.899)	-2.270 (-7.097)
Capital- (net worth/ttl asts)	-8.083 (-16.403)	-25.513 (-8.465)	-7.996 (-6.613)	-9.850 (-9.693)	-53.733 (-12.797)	0.545 (0.560)
Asset Quality- (other real estate/ttl asts)	0.747 (0.449)	-2.855 (-0.510)	-2.327 (-0.494)	6.298 (2.038)	21.373 (3.156)	4.752 (0.924)
Management Efficiency- (non-int exp/ttl asts)	1.883 (0.652)	23.730 (2.653)	3.737 (0.684)	-15.094 (-2.148)	-3.055 (-0.281)	9.167 (1.654)
Earnings Ability- (net inc/ttl asts)	-24.672 (-9.607)	26.762 (2.976)	-14.059 (-3.194)	-14.523 (-3.181)	-33.717 (-2.551)	-51.943 (-6.699)
Liquidity- (amt elig for reg liq/ttl asts)	-8.417 (-10.003)	-3.172 (-1.297)	-2.174 (-1.148)	-2.587 (-1.961)	-4.945 (-1.919)	-14.703 (-6.788)
Uchg- ($(MVPE-MVPE_U)$/ Market Asts	21.271 (6.180)	-13.514 (-0.756)	-8.195 (-0.559)	14.049 (1.926)	17.699 (1.873)	19.511 (2.767)
AIC	4452	394	477	1026	613	1148
LRI	0.270	0.303	0.241	0.277	0.675	0.171

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 26 - Logit regression of year two failures onto base CAMEL and IRR variables except other real estate / total assets is used for asset quality.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.221 (-13.866)	-1.260 (-2.039)	-1.533 (-4.321)	-0.750 (-2.016)	-1.691 (-4.372)	-2.587 -7.694
Capital- (net worth/ttl asts)	-7.471 (-12.308)	-18.198 (-5.575)	-12.862 (-7.959)	-23.029 (-10.568)	-36.017 (-9.742)	-2.749 (-2.681)
Asset Quality- (other real estate/ttl asts)	9.473 (5.464)	5.445 (1.513)	10.114 (3.023)	26.241 (5.803)	22.549 (4.187)	12.751 (2.333)
Management Efficiency- (non-int exp/ttl asts)	9.082 (2.919)	10.410 (1.039)	-10.463 (-1.365)	-8.015 (-1.035)	25.067 (3.524)	13.551 (2.179)
Earnings Ability- (net inc/ttl asts)	-17.769 (-5.089)	17.396 (1.873)	-18.011 (-2.669)	-25.558 (-2.695)	0.631 (0.047)	20.737 (2.055)
Liquidity- (amt elig for reg liq/ttl asts)	-8.343 (-11.717)	-12.217 (-3.893)	-7.161 (-5.110)	-8.692 (-5.462)	-3.805 (-2.475)	-5.530 (-3.508)
Uchg- $(MVPE-MVPE_u)/$ Market Asts	11.041 (3.476)	-39.736 (-2.575)	4.753 (0.587)	4.126 (0.655)	19.583 (2.845)	5.469 (0.685)
AIC	5557	489	1105	1254	1136	1056
LRI	0.156	0.186	0.243	0.342	0.183	0.040

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 27 - Logit regression of year one failures onto base CAMEL and IRR variables except percentage change of median real estate is used for asset quality.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.627 (-15.045)	-3.222 (-4.487)	-3.331 (-6.415)	-2.306 (-5.840)	-1.402 (-2.628)	-2.198 (-6.560)
Capital- (net worth/ttl asts)	-7.783 (-16.048)	-24.635 (-8.300)	-7.588 (-6.461)	-9.360 (-9.450)	-52.676 (-12.542)	0.571 (0.585)
Asset Quality- (percentage change in real estate value)	-4.931 (-6.414)	-3.567 (-1.128)	-4.182 (-1.858)	-8.387 (-4.420)	-2.492 (-1.530)	-0.981 (-0.653)
Management Efficiency- (non-int exp/ttl asts)	3.327 (1.133)	23.725 (2.627)	3.459 (0.635)	-12.483 (-1.839)	1.613 (0.141)	9.274 (1.674)
Earnings Ability- (net inc/ttl asts)	-22.719 (-8.896)	25.541 (2.839)	-13.311 (-2.987)	-12.890 (-2.847)	-35.815 (-2.805)	-52.420 (-6.787)
Liquidity- (amt elig for reg liq/ttl asts)	-8.168 (-9.776)	-2.892 (-1.208)	-1.880 (-1.011)	-2.602 (-1.992)	-5.794 (-2.221)	-14.950 (-6.893)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	18.988 (5.450)	-13.991 (-0.784)	-14.738 (-1.006)	10.575 (1.443)	17.164 (1.822)	19.796 (2.804)
AIC	4407	393	474	1008	618	1148
LRI	0.277	0.306	0.247	0.290	0.672	0.171

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 28 - Logit regression of year two failures onto base CAMEL and IRR variables except percentage change of median real estate is used for asset quality.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-1.817 (-11.156)	-1.054 (-1.683)	-1.161 (-3.346)	-0.001 (-0.004)	-1.380 (-3.525)	-2.480 (-7.018)
Capital- (net worth/ttl asts)	-7.337 (-12.332)	-17.824 (-5.391)	-12.834 (-8.227)	-21.780 (-10.255)	-34.930 (-9.475)	-2.669 (-2.633)
Asset Quality- (percentage change in real estate value)	-7.867 (-10.827)	-6.258 (-1.996)	-7.815 (-5.541)	-12.826 (-7.338)	-6.504 (-4.881)	-1.338 (-0.813)
Management Efficiency- (non-int exp/ttl asts)	11.609 (3.675)	10.846 (1.064)	-5.970 (-0.858)	-3.252 (-0.412)	30.935 (4.356)	13.912 (2.257)
Earnings Ability- (net inc/ttl asts)	-15.256 (-4.502)	15.208 (1.589)	-12.782 (-1.981)	-17.149 (-1.918)	3.237 (0.243)	16.912 (1.657)
Liquidity- (amt elig for reg liq/ttl asts)	-8.415 (-11.814)	-12.023 (-3.878)	-6.822 (-4.921)	-9.308 (-5.803)	-4.633 (-2.974)	-5.841 (-3.681)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	8.773 (2.731)	-36.876 (-2.420)	1.436 (0.174)	0.054 (0.008)	16.390 (2.341)	6.033 (0.747)
AIC	5451	486	1080	1216	1124	1059
LRI	0.172	0.192	0.260	0.363	0.191	0.037

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 29 - Logit regression of year one failures onto base CAMEL and IRR variables except net income / total assets is used for earnings.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.867 (-16.527)	-3.261 (-4.576)	-3.538 (-7.078)	-2.664 (-7.134)	-1.740 (-3.201)	-2.293 (-7.546)
Capital- (net worth/ttl asts)	-8.541 (-15.767)	-19.901 (-7.326)	-8.411 (-6.447)	-9.480 (-9.029)	-54.160 (-13.699)	-1.472 (-1.577)
Asset Quality- (repos'd asts/ttl asts)	5.385 (6.337)	2.047 (0.491)	3.029 (1.291)	5.442 (3.658)	10.911 (3.787)	4.351 (2.600)
Management Efficiency- (non-int exp/ttl asts)	8.226 (2.810)	12.680 (1.434)	6.896 (1.247)	-12.797 (-2.021)	7.034 (0.665)	19.380 (3.943)
Earnings Ability- (int inc/int exp)	0.000 (0.648)	-0.001 (-0.161)	-0.020 (-0.835)	-0.001 (-0.259)	-0.002 (-0.299)	0.002 (2.842)
Liquidity- (amt elig for reg liq/ttl asts)	-8.657 (-10.239)	-3.250 (-1.339)	-2.240 (-1.174)	-2.712 (-2.053)	-5.622 (-2.066)	-15.419 (-7.276)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	17.138 (4.828)	-13.915 (-0.767)	-12.691 (-0.830)	8.230 (1.091)	16.926 (1.782)	18.856 (2.696)
AIC	4522	403	486	1030	617	1198
LRI	0.258	0.287	0.227	0.274	0.673	0.134

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 30 - Logit regression of year two failures onto base CAMEL and IRR variables except net income / total assets is used for earnings.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-2.396 (-14.805)	-1.357 (-2.201)	-1.755 (-5.070)	-1.223 (-3.118)	-2.084 (-5.367)	-2.603 (-7.896)
Capital- (net worth/ttl asts)	-5.782 (-9.424)	-13.351 (-4.700)	-12.040 (-7.577)	-17.941 (-9.158)	-30.893 (-8.870)	-0.785 (-0.705)
Asset Quality- (repos'd asts/ttl asts)	11.147 (10.979)	4.985 (1.339)	8.145 (3.847)	25.147 (8.685)	19.196 (6.431)	2.599 (1.247)
Management Efficiency- (non-int exp/ttl asts)	13.285 (4.416)	8.348 (0.835)	-1.478 (-0.226)	-5.792 (-0.694)	24.872 (3.742)	13.265 (2.259)
Earnings Ability- (int inc/int exp)	0.000 (-0.155)	-0.015 (-0.668)	-0.014 (-1.228)	0.000 (0.113)	0.002 (2.050)	-0.002 (-0.525)
Liquidity- (amt elig for reg liq/ttl asts)	-8.306 (-11.602)	-12.206 (-3.858)	-6.805 (-4.847)	-8.243 (-5.254)	-4.413 (-2.765)	-5.737 (-3.612)
Uchg- $(MVPE-MVPE_u)/$ Market Asts	6.797 (2.061)	-39.150 (-2.518)	1.290 (0.151)	-0.202 (-0.030)	18.632 (2.605)	3.484 (0.422)
AIC	5494	492	1103	1208	1099	1061
LRI	0.166	0.182	0.244	0.367	0.210	0.035

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 31 - Logit regression of year one failures onto base CAMEL and IRR variables except broker deposits / total assets is used for liquidity.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-3.932 (-25.583)	-4.026 (-5.859)	-3.835 (-8.785)	-3.148 (-8.901)	-2.260 (-4.283)	-3.737 (-13.270)
Capital- (net worth/ttl asts)	-6.616 (-11.932)	-25.517 (-7.652)	-7.480 (-5.480)	-8.080 (-7.209)	-50.963 (-11.983)	1.234 (1.171)
Asset Quality- (repos'd asts/ttl asts)	4.424 (5.040)	1.091 (0.234)	2.740 (1.124)	4.937 (3.254)	9.829 (3.284)	2.146 (1.127)
Management Efficiency- (non-int exp/ttl asts)	3.924 (1.357)	27.042 (2.969)	3.437 (0.624)	-14.072 (-2.073)	1.606 (0.146)	10.273 (1.867)
Earnings Ability- (int inc/int exp)	-23.577 (-9.138)	30.512 (3.291)	-15.346 (-3.530)	-13.998 (-3.100)	-28.411 (-2.240)	-49.461 (-6.377)
Liquidity- (brokered deposits/ttl asts)	2.075 (3.390)	4.059 (1.897)	-3.392 (-1.056)	0.627 (0.491)	0.806 (0.423)	2.886 (3.003)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	21.487 (5.999)	-9.483 (-0.516)	-15.151 (-0.975)	11.444 (1.518)	18.064 (1.891)	19.324 (2.677)
AIC	4552	393	476	1024	616	1213
LRI	0.254	0.305	0.243	0.279	0.673	0.123

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 32 - Logit regression of year two failures onto base CAMEL and IRR variables except broker deposits / total assets is used for liquidity.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant	-3.444 (-23.814)	-2.587 (-4.292)	-2.660 (-8.404)	-2.301 (-6.247)	-2.391 (-6.260)	-3.302 (-10.764)
Capital- (net worth/ttl asts)	-5.072 (-7.766)	-19.764 (-5.810)	-11.552 (-6.877)	-17.348 (-8.027)	-33.164 (-9.301)	-1.796 (-1.554)
Asset Quality- (repos'd asts/ttl asts)	10.979 (10.695)	6.111 (1.696)	8.993 (4.213)	25.266 (8.547)	19.893 (6.595)	2.769 (1.309)
Management Efficiency- (non-int exp/ttl asts)	11.880 (4.079)	12.668 (1.224)	-3.526 (-0.515)	-5.969 (-0.717)	22.710 (3.357)	14.325 (2.309)
Earnings Ability- (net inc/ttl asts)	-12.483 (-3.665)	20.574 (2.106)	-12.321 (-1.829)	-9.328 (-1.150)	7.045 (0.591)	23.460 (2.178)
Liquidity- (brokered deposits/ttl asts)	2.928 (5.320)	2.633 (1.302)	2.315 (1.473)	4.430 (4.293)	2.547 (2.128)	3.124 (2.652)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	10.936 (3.317)	-39.722 (-2.508)	1.028 (0.119)	4.620 (0.706)	19.883 (2.793)	5.826 (0.707)
AIC	5643	511	1132	1227	1107	1070
LRI	0.143	0.148	0.224	0.356	0.204	0.027

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 33 - Logit regression of year one failures onto base CAMEL and IRR variables except cash and securities / total assets is used for liquidity.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-3.884 (-24.815)	-3.721 (-5.592)	-3.864 (-8.736)	-3.158 (-8.805)	-2.231 (-4.214)	-3.583 (-12.625)
Capital- (net worth/ttl asts)	-6.696 (-12.117)	-25.494 (-7.603)	-7.122 (-5.283)	-8.012 (-7.158)	-50.884 (-11.996)	0.720 (0.700)
Asset Quality- (repos'd asts/ttl asts)	4.325 (4.913)	1.839 (0.414)	2.819 (1.158)	4.830 (3.202)	10.090 (3.346)	1.899 (0.979)
Management Efficiency- (non-int exp/ttl asts)	3.905 (1.332)	24.154 (2.679)	4.189 (0.773)	-13.622 (-2.014)	1.220 (0.110)	9.484 (1.707)
Earnings Ability- (net inc/ttl asts)	-24.162 (-9.329)	26.921 (2.948)	-14.158 (-3.267)	-14.232 (-3.131)	-29.727 (-2.403)	-51.730 (-6.677)
Liquidity- (cash and securities/ttl asts)	-2.517 (-3.009)	0.100 (0.032)	-0.902 (-0.305)	-2.735 (-1.539)	0.643 (0.313)	-2.816 (-1.576)
Uchg- $(MVPE-MVPE_U)$/ Market Asts	25.412 (6.505)	-15.119 (-0.824)	-14.288 (-0.886)	15.968 (1.946)	16.637 (1.586)	21.819 (2.792)
AIC	4552	396	477	1021	616	1218
LRI	0.254	0.300	0.241	0.280	0.673	0.119

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the pooled sample period as shown by the column headings. Failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 34 - Logit regression of year two failures onto base CAMEL and IRR variables except cash and securities / total assets is used for liquidity.

	Data Period for Independent Variables					
	1985-89	1985	1986	1987	1988	1989
Constant-	-3.359 (-22.975)	-2.441 (-4.126)	-2.607 (-7.983)	-2.113 (-5.722)	-2.357 (-6.184)	-3.187 (-10.392)
Capital- (net worth/ttl asts)	-5.233 (-8.071)	-19.984 (-5.851)	-11.294 (-6.748)	-17.425 (-8.152)	-33.058 (-9.375)	-2.147 (-1.867)
Asset Quality- (repos'd asts/ttl asts)	11.094 (10.821)	6.456 (1.820)	8.537 (3.936)	26.185 (8.825)	20.079 (6.678)	2.897 (1.351)
Management Efficiency- (non-int exp/ttl asts)	12.215 (4.148)	11.345 (1.091)	-3.144 (-0.450)	-8.509 (-1.005)	23.535 (3.556)	14.288 (2.322)
Earnings Ability- (net inc/ttl asts)	-12.996 (-3.829)	18.249 (1.927)	-12.610 (-1.866)	-11.505 (-1.392)	7.130 (0.595)	19.618 (1.855)
Liquidity- (cash and securities/ttl asts)	-1.585 (-2.248)	0.827 (0.337)	-3.496 (-1.984)	-0.115 (-0.087)	-1.012 (-0.658)	-0.789 (-0.443)
Uchg- $(MVPE-MVPE_u)$/ Market Asts	12.440 (3.569)	-43.489 (-2.791)	7.546 (0.786)	3.279 (0.463)	20.873 (2.747)	5.391 (0.634)
AIC	5661	513	1130	1243	1110	1075
LRI	0.140	0.146	0.225	0.348	0.201	0.022

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end data, either individual years or the entire sample period as shown by the column headings. Failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

N.C.- no convergeance

Table 35 - Logit regression of year one failures onto optimal CAMEL and IRR variables.

Constant-	8.316 (13.059)
Capital-alternate exp(net worth/ttl asts)	-10.769 (-19.016)
Asset Quality- (percentage change in real estate value)	-4.574 (-5.923)
Management Efficiency- (non-int exp/ttl asts)	0.298 (0.102)
Earnings Ability- (net inc/ttl asts)	-17.850 (-7.097)
Liquidity- (amt elig for reg liq/ttl asts)	-7.938 (-9.436)
Uchg- $(MVPE-MVPE_u)$/Market Asts	17.594 (4.956)
AIC	4290
LRI	0.297

Key: Optimality is defined as the variable which provides the highest LRI when substituted in with the base CAMEL variables and the base IRR. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.)

Table 36 - Logit regression of year two failures onto optimal CAMEL and IRR variables.

Constant-	8.360
	(11.168)
Capital-	-10.019
exp(net worth/ttl asts)	(-14.717)
Asset Quality-	-7.696
(percentage change in real estate value)	(-10.554)
Management Efficiency-	9.723
(non-int exp/ttl asts)	(2.961)
Earnings Ability-	-9.936
(net inc/ttl asts)	(-2.955)
Liquidity-	-8.187
(amt elig for reg liq/ttl asts)	(-11.457)
Uchg-	8.102
$(MVPE-MVPE_u)$/Market Asts	(2.493)
AIC	5372
LRI	0.184

Key: Optimality is defined as the variable which provides the highest LRI when substituted in with the base CAMEL variables and the base IRR. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.)

Table 37 - Logit regression of year one failures onto base and optimal CAMEL and all three IRR variables.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant	-3.577 (-7.166)	Constant	7.544 (8.615)
Capital- (net worth/ttl asts)	-6.049 (-9.907)	Capital- exp(net worth/ttl asts)	-10.563 (-16.173)
Asset Quality- (repos'd asts/ttl asts)	3.916 (4.513)	Asset Quality- (percentage change in real estate value)	-4.549 (-5.880)
Management Efficiency- (non-int exp/ttl asts)	2.951 (1.018)	Management Efficiency- (non-int exp/ttl asts)	0.209 (0.071)
Earnings Ability- (net inc/ttl asts)	-22.766 (-8.866)	Earnings Ability- (net inc/ttl asts)	-17.861 (-7.094)
Liquidity- (amt elig for reg liq/ttl asts)	-8.438 (-9.815)	Liquidity- (amt elig for reg liq/ttl asts)	-8.144 (-9.447)
Uchg- $(MVPE-MVPE_u)$/Market Asts	10.463 (2.359)	Uchg- $(MVPE-MVPE_u)$/Market Asts	15.637 (3.541)
ISF- (interest sensitive funds/ttl funds)	0.865 (1.542)	ISF- (interest sensitive funds/ttl funds)	0.691 (1.229)
SHORT- (s.t. liab's - s.t. asts)/ttl asts	0.769 (2.586)	SHORT- (s.t. liab's - s.t. asts)/ttl asts	0.137 (0.449)
AIC	4426	AIC	4293
LRI	0.275	LRI	0.297
LRT	9.056 (0.011)	LRT	1.735 (0.420)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 38 - Logit regression of year two failures onto base and optimal CAMEL and all three IRR variables.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant	-1.308 (-3.489)	Constant	9.760 (10.866)
Capital- (net worth/ttl asts)	-4.561 (-6.544)	Capital- exp(net worth/ttl asts)	-10.337 (-13.744)
Asset Quality- (repos'd asts/ttl asts)	10.530 (10.315)	Asset Quality- (percentage change in real estate value)	-7.709 (-10.572)
Management Efficiency- (non-int exp/ttl asts)	11.051 (3.701)	Management Efficiency- (non-int exp/ttl asts)	9.556 (2.929)
Earnings Ability- (net inc/ttl asts)	-13.282 (-3.952)	Earnings Ability- (net inc/ttl asts)	-10.057 (-2.995)
Liquidity- (amt elig for reg liq/ttl asts)	-7.833 (-10.863)	Liquidity- (amt elig for reg liq/ttl asts)	-7.736 (-10.711)
Uchg- $(MVPE-MVPE_u)$/Market Asts	6.151 (1.510)	Uchg- $(MVPE-MVPE_u)$/Market Asts	11.473 (2.846)
ISF- (interest sensitive funds/ttl funds)	-1.295 (-3.089)	ISF- (interest sensitive funds/ttl funds)	-1.336 (-3.174)
SHORT- (s.t. liab's - s.t. asts)/ttl asts	0.280 (1.051)	SHORT- (s.t. liab's - s.t. asts)/ttl asts	-0.170 (-0.625)
AIC	5472	AIC	5366
LRI	0.170	LRI	0.186
LRT	10.377 (0.006)	LRT	9.83 (0.007)

Key: Failure is represented by a one and health by a zero in the logit regression. Independent variables are from year-end, 1985-1989, and failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 39 - Logit regression of year one failures onto base CAMEL variables, each IRR variable, and an interactive product between capital and IRR.

	Interest Rate Risk (IRR)-		
	Uchg- (MVPE-MVPE$_u$)/Market Asts	ISF- (interest sensitive funds/ttl funds)	SHORT- (s.t. liab's - s.t. asts)/ttl asts
Constant-	-2.933	-3.520	-2.433
	(-16.700)	(-7.858)	(-18.240)
Capital- (net worth/ttl asts)	-1.122	39.848	-20.452
	(-1.041)	(14.865)	(-19.495)
Asset Quality- (repos'd asts/ttl asts)	1.821	2.540	5.296
	(1.847)	(3.056)	(6.796)
Management Efficiency- (non-int exp/ttl asts)	4.015	-1.355	2.554
	(1.357)	(-0.478)	(0.923)
Earnings Ability- (net inc/ttl asts)	-22.636	-15.328	-14.177
	(-8.775)	(-6.269)	(-5.972)
Liquidity- (amt elig for reg liq/ttl asts)	-8.217	-7.711	-7.724
	(-9.778)	(-9.043)	(-8.902)
IRR	240.400	63.161	-32.300
	(6.179)	(17.581)	(-16.827)
IRR*exp(capital)	-220.000	-61.456	33.877
	(-5.743)	(-17.495)	(17.522)
AIC	4399	4128	4091
LRI	0.279	0.324	0.330
LRT	33.685	323.13	341.516
	(0.000)	(0.000)	(0.000)

Key: Results are shown for each IRR variable tested. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 40 - Logit regression of year two failures onto base CAMEL variables, each IRR variable, and an interactive product between capital and IRR.

	Interest Rate Risk (IRR)-		
	Uchg- (MVPE-MVPE$_u$)/Market Asts	ISF- (interest sensitive funds/ttl funds)	SHORT- (s.t. liab's - s.t. asts)/ttl asts
Constant	-2.512 (-15.195)	-3.178 (-7.957)	-1.733 (-13.611)
Capital- (net worth/ttl asts)	-1.388 (-1.020)	48.021 (11.738)	-22.160 (-16.428)
Asset Quality- (repos'd asts/ttl asts)	9.756 (9.067)	9.515 (9.243)	11.789 (11.514)
Management Efficiency- (non-int exp/ttl asts)	11.563 (3.939)	9.188 (2.987)	13.244 (4.482)
Earnings Ability- (net inc/ttl asts)	-12.810 (-3.795)	-8.518 (-2.551)	-5.399 (-1.656)
Liquidity- (amt elig for reg liq/ttl asts)	-8.249 (-11.564)	-7.403 (-10.391)	-7.614 (-10.347)
IRR	140.000 (2.813)	67.678 (12.977)	-42.813 (-15.324)
IRR*exp(capital)	-128.400 (-2.683)	-66.226 (-13.269)	42.141 (15.534)
AIC	5473	5260	5145
LRI	0.169	0.201	0.219
LRT	7.133 (0.008)	217.48 (0.000)	334.625 (0.000)

Key: Results are shown for each IRR variable tested. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 41 - Logit regression of year one failures onto optimal CAMEL variables, each IRR variable, and an interactive product between capital and IRR.

	Interest Rate Risk (IRR)-		
	Uchg- (MVPE-MVPE$_u$)/Market Asts	ISF- (interest sensitive funds/ttl funds)	SHORT- (s.t. liab's - s.t. asts)/ttl asts
Constant-	9.483 (6.751)	32.956 (4.786)	22.421 (20.509)
Capital- exp(net worth/ttl asts)	-11.931 (-8.710)	-35.696 (-5.215)	-24.404 (-23.145)
Asset Quality- (percentage change in real estate value)	-4.640 (-5.970)	-4.867 (-6.280)	-4.073 (-5.275)
Management Efficiency- (non-int exp/ttl asts)	0.174 (0.059)	-0.249 (-0.084)	0.041 (0.014)
Earnings Ability- (net inc/ttl asts)	-17.796 (-7.085)	-16.857 (-6.761)	-11.488 (-4.976)
Liquidity- (amt elig for reg liq/ttl asts)	-7.914 (-9.420)	-8.504 (-9.874)	-7.298 (-8.457)
IRR	-15.659 (-0.439)	-25.380 (-3.475)	-27.091 (-16.957)
IRR*exp(capital)	33.301 (0.938)	26.451 (3.641)	28.682 (17.586)
AIC	4292	4297	3958
LRI	0.297	0.296	0.352
LRT	0.872 (0.350)		

Key: Results are shown for each IRR variable tested. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 42 - Logit regression of year two failures onto optimal CAMEL variables, each IRR variable, and an interactive product between capital and IRR.

	Interest Rate Risk (IRR)-		
	Uchg- (MVPE-MVPE$_u$)/Market Asts	ISF- (interest sensitive funds/ttl funds)	SHORT- (s.t. liab's - s.t. asts)/ttl asts
Constant	10.485 (6.034)	47.666 (5.867)	24.895 (17.888)
Capital- exp(net worth/ttl asts)	-12.078 (-7.250)	-47.027 (-5.958)	-25.904 (-19.417)
Asset Quality- (percentage change in real estate value)	-7.745 (-10.590)	-7.727 (-10.604)	-7.272 (-9.934)
Management Efficiency- (non-int exp/ttl asts)	9.595 (2.933)	10.214 (3.174)	11.407 (3.635)
Earnings Ability- (net inc/ttl asts)	-9.997 (-2.984)	-9.153 (-2.815)	-5.571 (-1.716)
Liquidity- (amt elig for reg liq/ttl asts)	-8.180 (-11.457)	-7.869 (-10.897)	-7.521 (-10.271)
IRR	-55.270 (-1.195)	-41.657 (-4.833)	-33.936 (-14.157)
IRR*exp(capital)	61.590 (1.373)	39.398 (4.707)	33.603 (14.324)
AIC	5371	5348	5081
LRI	0.184	0.188	0.229
LRT	1.857 (0.173)		

Key: Results are shown for each IRR variable tested. Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the following thirteen to twenty-four months (year two). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 43 - Logit regression of year one failures onto base CAMEL variables, each IRR variable, and a series of interactive terms which include sequential dummies for capital levels.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant-	-2.285 (-12.967)	Constant	-0.792 (-1.291)
Capital- (net worth/ttl asts)	-1.004 (-2.157)	Capital-alternate exp(net worth/ttl asts)	-1.363 (-2.456)
Asset Quality- (repos'd asts/ttl asts)	-0.366 (-0.483)	Asset Quality- (percentage change in real estate value)	-2.389 (-3.199)
Management Efficiency- (non-int exp/ttl asts)	3.879 (1.501)	Management Efficiency- (non-int exp/ttl asts)	4.177 (1.602)
Earnings Ability- (net inc/ttl asts)	-11.225 (-5.626)	Earnings Ability- (net inc/ttl asts)	-9.990 (-5.036)
Liquidity- (amt elig for reg liq/ttl asts)	-4.897 (-6.05)	Liquidity- (amt elig for reg liq/ttl asts)	-4.713 (-5.842)
Uchg*C1- (MVPE-$MVPE_U$)/Market Asts (C1=1 when NW/ttl asts<0)	53.942 (12.719)	Uchg*C1- (MVPE-$MVPE_U$)/Market Asts (C1=1 when NW/ttl asts<0)	50.611 (12.246)
Uchg*C2- (C2=1 when 0<NW/ttl asts<.02)	18.1 (3.938)	Uchg*C2- (C2=1 when 0<NW/ttl asts<.02)	16.389 (3.575)
Uchg*C3- (C3=1 when .02<NW/ttl asts<.05)	-46.545 (-7.368)	Uchg*C3- (C3=1 when .02<NW/ttl asts<.05)	-47.041 (-7.501)
Uchg*C4- (C4=1 when NW/ttl asts>.05)	-112.8 (-10.464)	Uchg*C4- (C4=1 when NW/ttl asts>.05)	-112.100 (-10.436)
AIC	3451	AIC	3439
LRI	0.435	LRI	0.438
LRT	984.6 (0.000)	LRT	857.4 (0.000)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are in parenthesis.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 44 - Logit regression of year one failures onto base or optimal CAMEL and IRR variables and a series of interactive terms which include sequential dummies for capital levels.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant	-2.285 (-12.967)	Constant	-0.792 (-1.291)
Capital- (net worth/ttl asts)	-1.004 (-2.157)	Capital-alternate exp(net worth/ttl asts)	-1.363 (-2.456)
Asset Quality- (repos'd asts/ttl asts)	-0.366 (-0.483)	Asset Quality- (percentage change in real estate value)	-2.389 (-3.199)
Management Efficiency- (non-int exp/ttl asts)	3.879 (1.501)	Management Efficiency- (non-int exp/ttl asts)	4.177 (1.602)
Earnings Ability- (net inc/ttl asts)	-11.225 (-5.626)	Earnings Ability- (net inc/ttl asts)	-9.990 (-5.036)
Liquidity- (amt elig for reg liq/ttl asts)	-4.897 (-6.050)	Liquidity- (amt elig for reg liq/ttl asts)	-4.713 (-5.842)
Uchg- ($MVPE-MVPE_u$)/ Market Asts	-112.800 (-10.464)	Uchg- ($MVPE-MVPE_u$)/Market Asts	-112.100 (-10.436)
Uchg*C1- (C1=1 when NW/ttl asts<0)	166.700 (17.023)	Uchg*C1- (C1=1 when NW/ttl asts<0)	162.700 (16.413)
Uchg*C2- (C2=1 when 0<NW/ttl asts<.02)	130.900 (13.403)	Uchg*C2- (C2=1 when 0<NW/ttl asts<.02)	128.500 (13.132)
Uchg*C3- (C3=1 when .02<NW/ttl asts<.05)	66.249 (6.609)	Uchg*C3- (C3=1 when .02<NW/ttl asts<.05)	65.065 (6.495)
AIC	3452	AIC	3439
LRI	0.435	LRI	0.438
LRT	984.6 (0.000)	LRT	857.4 (0.000)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 45 - Logit regression of year one failures onto base or optimal CAMEL and IRR variables and a series of interactive terms which include sequential dummies for asset levels.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant	-2.959 (-16.783)	Constant	8.272 (12.897)
Capital- (net worth/ttl asts)	-6.757 (-12.099)	Capital-alternate exp(net worth/ttl asts)	-10.761 (-18.929)
Asset Quality- (repos'd asts/ttl asts)	4.033 (4.630)	Asset Quality- (percentage change in real estate value)	-4.660 (-6.022)
Management Efficiency- (non-int exp/ttl asts)	3.792 (1.282)	Management Efficiency- (non-int exp/ttl asts)	0.875 (0.293)
Earnings Ability- (net inc/ttl asts)	-22.606 (-8.795)	Earnings Ability- (net inc/ttl asts)	-17.750 (-7.074)
Liquidity- (amt elig for reg liq/ttl asts)	-7.990 (-9.340)	Liquidity- (amt elig for reg liq/ttl asts)	-7.656 (-8.932)
Uchg*A1- ($MVPE-MVPE_u$)/Market Asts (A1=1 when ttl asts<100,000,000)	16.513 (1.521)	Uchg*A1- ($MVPE-MVPE_u$)/Market Asts (A1=1 when ttl asts<100,000,000)	15.993 (1.815)
Uchg*A2- (A2=1 when 100,000,000<ttl asts<1,000,000,000)	18.074 (1.180)	Uchg*A2- (A2=1 when 100,000,000<ttl asts<1,000,000,000)	17.668 (1.461)
Uchg*A3- (A3=1 when ttl asts>1,000,000,000)	22.696 (4.687)	Uchg*A3- (A3=1 when ttl asts>1,000,000,000)	23.406 (4.847)
AIC	4432	AIC	4291
LRI	0.274	LRI	0.297
LRT	2.3 (0.317)	LRT	3.2 (0.202)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 46 - Logit regression of year one failures onto base or optimal CAMEL and IRR variables and a series of interactive terms which include sequential dummies for asset levels.

Base CAMEL Variables		Optimal CAMEL Variables	
Constant	-2.959 (-16.783)	Constant	8.272 (12.897)
Capital- (net worth/ttl asts)	-6.757 (-12.099)	Capital- alternate exp(net worth/ttl asts)	-10.761 (-18.929)
Asset Quality- (repos'd asts/ttl asts)	4.033 (4.630)	Asset Quality- (percentage change in real estate value)	-4.660 (-6.022)
Management Efficiency- (non-int exp/ttl asts)	3.792 (1.282)	Management Efficiency- (non-int exp/ttl asts)	0.875 (0.293)
Earnings Ability- (net inc/ttl asts)	-22.606 (-8.795)	Earnings Ability- (net inc/ttl asts)	-17.750 (-7.074)
Liquidity- (amt elig for reg liq/ttl asts)	-7.990 (-9.340)	Liquidity- (amt elig for reg liq/ttl asts)	-7.656 (-8.932)
Uchg- (MVPE-$MVPE_u$)/ Market Asts	22.696 (4.687)	Uchg- (MVPE-$MVPE_u$)/Market Asts	23.406 (4.847)
Uchg*A1- (A1=1 when ttl asts<100,000,000)	-6.183 (-1.521)	Uchg*A1- (A1=1 when ttl asts<100,000,000)	-7.413 (-1.815)
Uchg*A2- (A2=1 when 100,000,000<ttl asts<1,000,000,000)	-4.622 (-1.180)	Uchg*A2- (A2=1 when 100,000,000<ttl asts<1,000,000,000)	-5.738 (-1.461)
AIC	4432	AIC	4291
LRI	0.274	LRI	0.297
LRT	2.3 (0.317)	LRT	3.2 (0.202)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 47 - Logit regression of year one failures onto base CAMEL and IRR variables and a series of interactive terms which include sequential dummies for IRR levels.

	Capital- (net worth/ttl asts)	Capital- (mnpv/market)	Capital- exp(net worth/ttl asts)
Constant	-2.927	-3.444	7.527
	(-16.853)	(-21.139)	(10.083)
I1*Capital- (I1=1 when Uchg<.02)	-8.330	-0.630	-10.222
	(-6.057)	(-3.790)	(-15.202)
I2*Capital- (I2=1 when .02<=Uchg<.04)	-7.102	-4.122	-10.325
	(-11.116)	(-10.770)	(-15.607)
I3*Capital- (I3=1 when .04<=Uchg)	-5.237	-2.556	-10.392
	(-6.341)	(-4.107)	(-15.417)
Asset Quality- (repos'd asts/ttl asts)	4.661	7.745	2.126
	(5.214)	(10.388)	(2.414)
Management Efficiency- (net inc/gr inc)	3.120	11.852	-0.372
	(1.080)	(4.583)	(-0.128)
Earnings Ability- (net inc/ttl asts)	-22.150	-28.288	-18.663
	(-8.622)	(-11.378)	(-7.338)
Liquidity- (amt elig for reg liq/ttl asts)	-8.114	-8.047	-8.105
	(-9.665)	(-10.008)	(-9.575)
Uchg- $(MVPE-MVPE_u)$/Market Asts	17.488	20.143	21.050
	(4.887)	(5.784)	(3.304)
AIC	4428	4460	4326
LRI	0.275	0.269	0.291
LRT	6.3	1.7	0.4
	(0.043)	(0.427)	(0.819)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) Akaike Information Criteria (AIC) considers the number of parameters in the regression and allows cross specification comparison. The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 48 - Logit regression of year one failures onto base CAMEL and IRR variables and a series of interactive terms which include sequential dummies for IRR levels.

	Capital- (net worth/ttl asts)	Capital- (mnpv/market)	Capital- exp(net worth/ttl asts)
Constant-	-2.927	-3.354	7.527
	(-16.853)	(-20.411)	(10.083)
Capital-	-5.237	-4.621	-10.392
	(-6.343)	(-7.982)	(-15.417)
I1*Capital-	-3.093	0.431	0.171
(I1=1 when Uchg<.02)	(-2.027)	(0.941)	(0.643)
I2*Capital-	-1.865	0.191	0.067
(I2=1 when .02<=Uchg<.04)	(-2.168)	(0.306)	(0.420)
Asset Quality-	4.661	7.092	2.126
(repos'd asts/ttl asts)	(5.214)	(9.545)	(2.414)
Management Efficiency-	3.120	10.524	-0.372
(net inc/gr inc)	(1.080)	(3.923)	(-0.128)
Earnings Ability-	-22.150	-26.896	-18.663
(net inc/ttl asts)	(-8.622)	(-10.804)	(-7.338)
Liquidity-	-8.114	-8.246	-8.105
(amt elig for reg liq/ttl asts)	(-9.665)	(-10.217)	(-9.575)
Uchg-	17.488	19.719	21.050
$(MVPE-MVPE_u)$/Market Asts	(4.887)	(5.587)	(3.304)
AIC	4428	4403	4326
LRI	0.275	0.279	0.291
LRT	6.3	1.7	0.4
	(0.043)	(0.427)	(0.819)

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). (t-statistics are below parameter estimates.) Akaike Information Criteria (AIC) considers the number of parameters in the regression and allows cross specification comparison. The Likelihood Ratio Test (LRT) tests the hypothesis that parameters for the dummy variables are different. (Chi-square statistics are in parenthesis.)

Table 49 - Logit regression of year one failures onto all CAMEL and IRR variables, a variable for hedging activities, and a size variable.

Constant-	-5.161	3.876	-2.920
	(-6.235)	(3.322)	(-17.008)
Capital-	-4.737		-6.875
(net worth/ttl asts)	(-7.569)		(-12.299)
Capital-	-2.999	-2.539	
(MVPE/market)	(-8.268)	(-6.793)	
Capital-		-8.710	
exp(net worth/ttl asts)		(-11.364)	
Asset Quality-	2.556	0.878	4.001
(repos'd asts/ttl asts)	(2.885)	(0.982)	(4.626)
Asset Quality-	0.261	-0.183	
(other real estate/ttl asts)	(0.152)	(-0.105)	
Asset Quality-	-4.246	-4.455	
(percentage change in real estate value)	(-5.325)	(-5.519)	
Management Efficiency-	5.105	1.543	2.632
(net inc/gr inc)	(1.672)	(0.506)	(0.923)
Earnings Ability-	-20.387	-16.800	-22.905
(net inc/ttl asts)	(-8.080)	(-6.723)	(-8.906)
Earnings Ability-	0.000	0.000	
(int inc/int exp)	(0.753)	(1.500)	
Liquidity-	-8.096	-7.955	-8.025
(amt elig for reg liq/ttl asts)	(-9.170)	(-8.923)	(-9.578)
Liquidity-	0.688	0.762	
(brokered deposits/ttl asts)	(1.059)	(1.170)	
Liquidity-	0.294	0.227	
(cash and securities/ttl asts)	(0.341)	(0.261)	
Hedging Securities-	0.719	0.980	1.389
(Sum of hedging securities/Total Assets)	(1.760)	(2.451)	(3.756)
Size-	0.079	0.080	
Log(Total Assets)	(2.169)	(2.177)	
Uchg-	15.596	18.752	17.028
(MVPE-$MVPE_u$)/Market Asts	(3.285)	(3.858)	(4.778)
SHORT-	0.023	-0.423	
(s.t. liab's - s.t. asts)/ttl asts	(0.073)	(-1.343)	
ISF-	1.630	1.476	
(interest sensitive funds/ttl funds)	(2.639)	(2.373)	
AIC	4314	4233	4421
LRI	0.296	0.309	0.275

Key: Failure is represented by a one and health by a zero. Independent variables are from year-end, 1985-1989, and failure is from the immediately following twelve months (year one). Akaike Information Criteria (AIC) considers the number of parameters in the regression and allows cross specification comparison. (t-statistics are below parameter estimates.)

Table 50 - Results of the two index model with various portfolios of S&Ls as the independent variable.

	Model 1		Model 2	
	MKT	INTLT	MKT	INT1
TTLFIRM	0.665	0.001	0.680	-4.322
	(5.99)	(0.00)	(6.68)	(-2.41)
HCRTNS	0.628	0.000	0.640	-3.521
	(5.68)	(0.00)	(6.20)	(-1.94)
HIGHCAP	0.615	0.026	0.628	-2.828
	(6.54)	(0.14)	(7.13)	(-1.82)
MEDCAP	0.630	0.029	0.648	-4.116
	(4.76)	(0.11)	(5.23)	(-1.89)
LOWCAP	0.785	-.0858	0.798	-7.303
	(4.61)	(-0.26)	(5.17)	(-2.68)
HIGHAST	0.858	0.017	0.878	-5.123
	(4.73)	(0.05)	(5.15)	(-1.71)
LOWAST	0.624	-.016	0.636	-4.266
	(6.11)	(-0.08)	(6.84)	(-2.61)
Quarterly Data: 1986:1-1989:4				
Ibbotsen/Asso	1.147	1.267	1.431	6.990
	(2.84)	(4.93)	(4.98)	(1.62)
CRSP	-.644	.145	.030	-7.748
	(0.94)	(0.33)	(0.07)	(-1.21)

Key: The data are monthly returns from CRSP for the independent variable and from Ibbotsen & Associates for the indices. The market index (MKT) is the S&P 500, the long term interest rate index (INTLT) is the total return on long term government bonds, and the short term index (INT1) is the total return on twelve month Treasury bills. The test period is 1985:1 through 1989:12. All returns are excess returns and the interest rate indices are 'whitened'. (t-statistics are in parenthesis below.)

Table 51 - Results of the single stage model.

	Model 1		
	MKT	INTLT*IRR	INTLT
Uchg	0.568 (21.47)	-5.158 (-1.01)	0.150 (0.94)
SHORT	0.566 (21.46)	-0.855 (-1.55)	0.729 (1.53)
ISF	0.566 (21.47)	-0.186 (-0.56)	0.012 (0.21)
	Model 2		
	MKT	INT1*IRR	INT1
Uchg	0.572 (22.27)	44.053 (1.25)	-3.921 (-3.22)
SHORT	0.575 (22.49)	-2.171 (-0.75)	-0.724 (-0.29)
ISF	0.576 (22.52)	-1.933 (-0.60)	-2.390 (-4.42)

Key: The data are monthly returns from CRSP for the independent variable and from Ibbotsen & Associates for the indices. The market index (MKT) is the S&P 500, the long term interest rate index (INTLT) is the total return on long term government bonds, and the short term index (INT1) is the total return on twelve month Treasury bills. The test period is 1985:1 through 1989:12. All returns are excess returns and the interest rate indices are 'whitened'. (t-statistics are in parenthesis below.)