The Effects of Risk-based Capital on Wealth and Risk-taking in Banking

Sonya Williams Stanton
Max M. Fisher College of Business
The Ohio State University
Columbus, OH 43210
Phone: (614) 688-4091
FAX: (614) 292-2418
sonya@cob.ohio-state.edu

Current Draft: December 1998**

**Preliminary and Incomplete: Please do not circulate or quote without permission from the author.

I am appreciative of helpful comments and suggestions from Elazar Berkovitch, Victor Bernard, Brian Betker, Steve Buser, Mark Flannery, David Hirshleifer, Gautum Kaul, Stanley Kon and Patricia O'Brien. I am grateful for financial support from The Dice Center for Research in Financial Economics. Any errors are the responsibility of the author.

Abstract

I examine whether risk-based capital requirements caused changes in risk and wealth among U.S. banks. I find that banks with the lowest asset quality prior to the new regulation experienced relative improvement in quality in the post-regulatory period while asset quality deteriorated for banks with high quality assets. Furthermore, risk as measured by the variance of stock returns and residual variance increased immediately after the initial risk-based capital announcement. Surprisingly, across banks the change in risk does not decrease with bank charter values but decreases with loan quality. Finally, interest rate gap increased after risk-based capital was implemented. In the analysis of wealth effects, I find that risk-based capital standards were costly for U.S. banks. The new capital standards produced statistically and economically significant negative abnormal returns to shareholders of banks with the highest holdings of assets that were classified as "high risk" in the Accord. Moreover, the new standards may have unfairly penalized banks that made "good" commercial and consumer loans. Thus, risk-based capital standards appear to tax investment in assets classified as high risk without regard to the actual quality of assets within types. Additional evidence of the costliness of these standards is that upon passage of the Basle Accord there was a significant increase in the relative price of bank loans versus other short-term borrowing. I conclude that while risk-based capital was costly for banks, it did not lead to a reduction in risk by all banks.

1. Introduction

The Basle Accord of 1988 imposed risk-based capital requirements on commercial banks. These standards effectively raised capital requirements for commercial loans, most consumer loans and various off balance sheet activities. Most economists agree that these more restrictive requirements did impose costs on the banking industry.[1] This paper not only provides evidence on how these costs were distributed across banks it also analyzes the effect of risk-based capital on risk-taking by banks. The evidence indicates that the costs were not uniformly distributed and perhaps were not efficiently distributed. Moreover, it appears that the requirements did not uniformly reduce risk in banking. In fact, there was an increase in market measures of risk in the period immediately following the first announcement regarding adoption of risk-based capital standards. There was also an increase in interest rate risk in the period after risk-based capital was implemented and even some measures of credit risk increased for some banks.[2] Finally, it seems that there was a significant change in the pricing of certain types of loans. The change in loan pricing implies that either the average borrower risk increased and/or the required return on these loans increased after risk-based capital requirements were imposed.

While there is wide spread agreement that higher capital standards are costly for bank shareholders, there is less agreement about how these costs are distributed across the industry. Merton (1977) likens deposit insurance to a put option given to bank shareholders by the FDIC.

---

[1] Eyssell and Arshadi (1990) find negative abnormal returns to bank shareholders for a sample of 27 banks on announcements concerning the passage of the Basle Accord. These losses were significant for banks where the risk-based capital requirements were binding. Using weekly returns, Wagster (1997) finds insignificantly negative abnormal returns for a sample of 22 U.S. banks.

[2] These findings are consistent with Grenadier and Hall (1996). They conclude that banks may have substituted one type of risk (term structure risk) for others (default and market risk).

The weakest banks have the most to gain by exploiting this option and will take excessive risks. If risk-based capital standards reduce excessive risk-taking by weak banks, one might expect the weakest banks to bear the most significant losses upon the announcement of new capital standards. Alternatively, since risk-based capital requirements are based purely on asset classifications and accounting based measures of capital, banks which invest in the assets that are assigned a high risk classification and/or banks that have higher market-to-book capital may incur higher costs. This is exactly what I find. Banks with high risk-weighted assets and high market-to-book ratios sustain more significantly negative abnormal returns.

The 107 large banks analyzed in this paper experienced significantly negative abnormal returns over 4 announcements concerning the passage of risk-based capital. Shareholders in banks with heavy investments in assets classified as high risk, shareholders in banks where risk-based capital was binding, shareholders of banks with high charter value (or good growth opportunities) and shareholders in banks with either the worst or best loan quality (using 3 quality subsamples) had significant reductions in shareholder wealth. Shareholders in banks with heavy investments in assets classified as high risk experienced significant reductions in wealth regardless of their loan quality. Thus it appears that risk-based capital standards do not reward lower credit risk and may provide lower incentives for banks to make these types of loans. Thus, it appears that risk-based capital taxed investment in assets that were classified as high risk without regard to the actual riskiness of assets within given classifications. I infer from this result that the Arisk-based≅ capital standards unfairly penalized banks with large investments in relatively good quality commercial and industrial loans (i.e. the requirements did not account for differences in quality within loan classifications).

Another way to gauge the cost to the banking industry of risk-based capital is to examine changes in loan pricing. If risk-based capital standards raised the cost of capital, I expect the cost of loans to reflect this change. Alternatively, if risk-based capital led to changes in risk-taking incentives whereby banks attempt to increase credit risk to obtain a higher return on capital, I would expect an increase in loan pricing and an increase in bad loans. I find that there was an increase in the spreads between prime and commercial paper and prime and treasury bills in the period following implementation of risk-based capital standards. However, I also find that loan charge-off rates fell during this period. Together this evidence seems to indicate that in the aggregate, banks did not increase credit risk after risk-based capital was implemented.

This paper also investigates the on-going theoretical debate concerning the effect of bank capital regulation on bank risk-taking. Keeley and Furlong (1990) and others, argue that bank risk will always decrease when capital requirements are raised because higher capital requirements reduce the value of the shareholders= put option and forces bank shareholders to bear more of the consequences of risky investments. Others like Kim and Santomero (1988) suggest that some banks will increase risk-taking to offset the loss in utility from lower leverage and the direction of the subsequent change in risk for a particular bank will depend on that bank=s preferences for risk.

Stanton (1998) suggests that risk will increase for some banks and decrease for others. However, the direction of the change does not arise from differences in risk preferences across banks but is due to differences in each bank=s loan opportunity set and their relative incentives to

over- or under- invest in certain types of loans.[3] Banks with many profitable loan or growth opportunities (e.g. high charter value) have a relatively more severe underinvestment problem and banks with weak loan opportunities (e.g. low charter value) have a more severe overinvestment problem. When the underinvestment incentive is more severe than the overinvestment incentive, raising capital requirements may lead to higher portfolio risk as banks reject more risk-reducing positive NPV loans. Alternatively, when the overinvestment incentive dominates, higher capital requirements will lead to lower risk.[4] The results on bank risk following risk-based capital are consistent with these predictions.

Shareholders in banks with heavy investments in assets classified as high risk and banks with the worst loan quality did experience significant reductions in shareholder wealth. However, banks with poor loan quality prior to risk-based capital experienced an improvement in asset quality in the post-regulation period. Shareholders in banks with the highest asset quality but heavy investments in assets classified as high risk under the Basle agreement also had significant reductions in wealth. However, for these banks loan quality deteriorated in the post-announcement period. I also find that one measure of interest rate risk increased after risk-based capital was imposed and that banks with weak capital were more likely to increase their interest rate risk in the post risk-based capital period. This suggests that some banks may have substituted interest rate risk for credit risk. These findings contradict the predictions of Keeley and Furlong

[3] James (1988, 1989) and Stanton (1998) describe the underinvestment incentive in banking and analyze how capital requirements affect this incentive. Stanton (1998) also analyzes the overinvestment incentive and the trade-off between the two incentives under various financing methods.

[4] There are additional models of bank risk-taking incentives. For example, Marcus (1984) and Keeley (1990) analyze the effect of bank charter value on risk-taking. See Avery and Berger (1991) for a review of the literature on bank capital and risk-taking.

(1990). In addition, consistent with the prediction of increased rejection of risk-reducing positive NPV loans by banks with good loan opportunities, banks with high market-to-book ratios had significantly higher increases in stock return and residual variances in the period following the first risk-based capital announcement.

In the following section I briefly outline the empirical predictions of three models of capital regulation and bank risk. Section 3 contains an outline of the Basle Accord of 1988 and a description of the data and methodology. In section 4 the hypotheses and results are presented. Conclusions are contained in section 5.

2. Empirical Implications of Competing Models

Each of the following theories has either implicit or explicit predictions regarding changes in asset composition and risk-taking in commercial and industrial lending and securities investment under the newly imposed capital requirements. Predictions regarding changes in wealth can also be inferred from these theories. I perform various tests to determine which of these theories is consistent with the observed behavior of banks and bank equity returns following announcements regarding implementation of risk-based capital.

A. Asset Substitution

The asset substitution model was proposed by Kahane (1977), Kim and Santomero (1988) and others. It suggests that raising capital requirements will encourage some banks to choose higher risk portfolios. In a utility maximization framework this occurs as banks attempt to substitute for the loss in utility caused by the higher capital requirements by increasing asset risk. Banks may substitute higher risk assets for lower risk assets or increase other types of risk such as interest rate, exchange rate, liquidity or operational risks. This implies that banks may respond to

the higher capital requirements imposed on commercial loans by increasing the risk of commercial lending activities and/or by increasing other types of risk such as interest rate risk. The asset substitution model does not have many testable cross-sectional predictions regarding changes in risk since it relies on differences in risk preferences to distinguish between the two types of banks.

B. Put Option Analogy

The put option theory arises from interpretations of Merton's (1977) put option analogy of deposit insurance. According to the interpretations of Furlong and Keeley (1989) and Keeley and Furlong (1990), raising capital requirements reduces the value of the bank shareholders' put option and thereby reduces the value to the bank of undertaking excessive risk. Since shareholders will have a higher share of the losses associated with risky investments, the authors conclude that risk-taking will never increase when capital requirements are raised. Therefore, since commercial loans are subject to higher capital requirements under the new law, loan portfolio risk should decline. In addition, since higher capital requirements reduce the value of the bank's put option, this theory predicts that shareholder wealth will decrease. The decrease will be most significant for those banks with the highest valuation of the put option -- i.e. the weakest banks.

C. Underinvestment

Banks like non-financial corporations, have incentives to overinvest (accept negative net present value loans) and underinvest (reject positive net present value loans).[5] These incentives arise due to a debt overhang problem whereby the bank's fixed claimants may bear some or all of the costs associated with negative NPV loans and capture most or all of the profit associated with positive NPV loans. James (1988,1989) discusses the underinvestment problem in banking and

[5] These incentives are outlined in Jensen and Meckling (1976) and Myers (1977), respectively.

Stanton (1998) analyzes how various financing methods affect this problem. In particular, that analysis demonstrates that raising capital requirements reduces the overinvestment problem. However, both authors find that raising capital requirements will exacerbate the underinvestment problem. Stanton (1998) also suggests that banks will tend to overinvest in loans that are positively correlated with existing assets and underinvest in loans that are negatively correlated with existing assets. In other words, bank managers acting on behalf of shareholders will tend to reject positive NPV loans that may reduce the risk of their portfolio and accept some negative NPV loans that may increase the risk of their portfolio. When capital requirements are raised, fewer loans will be made because bank shareholders will capture less profit from either type of loan-- they will suffer larger losses from negative NPV loans and capture less profit from positive NPV loans.

Banks with many profitable loan opportunities are likely to face a more severe underinvestment problem than banks with poor loan opportunities. Since there is an incentive to reject marginally positive NPV loans that are negatively correlated with existing assets, higher capital requirements will lead to rejection of more of these loans and higher loan portfolio risk for these banks. Therefore, higher capital requirements may lead to higher loan portfolio risk for these banks. On the other hand, banks with very weak loan opportunities face a more severe overinvestment problem. Banks generally have an incentive to overinvest in loans that are positively correlated with existing assets. Since raising capital requirements decreases incentives to overinvest, banks in this group will reject more negative NPV loans and their portfolio risk should decline.

Changes in risk following risk-based capital standards will depend on each bank's loan opportunity set and existing level of risk. For example, among banks with very few valuable opportunities, the overinvestment problem will dominate the underinvestment problem. In this case, the predictions are similar to those derived from the put option model. For these banks the

decrease in acceptance of negative NPV, high risk loans will more than offset any increase in rejections of profitable loans and overall portfolio risk will decrease. The opposite is true for banks with profitable opportunities. For these banks, the magnitude of the rejections of profitable, risk-reducing loans may offset any decrease in overinvestment and on balance may lead to deterioration in asset quality. Portfolio risk is likely to increase for banks with profitable loan opportunities and decrease for banks with very few profitable loan opportunities. Unlike the asset substitution model the underinvestment model predicts what types of banks are likely to respond in this manner irrespective of risk preferences. Both models also predict that banks will undertake more interest rate risk because of the effectively lower capital requirements on government securities. The risk increase will be largest for banks with the riskiest existing deposits (i.e. weakly capitalized and/or low quality banks).

4. Data and Methodology

A. The Basle Accord of 1988

In 1988 twelve industrialized countries agreed to impose risk-based capital standards on international banks in their respective countries. It had taken over three years to reach an agreement. The purpose of the agreement was to ensure the safety and soundness of the international banking system and to level the playing field for global competitors. The risk-based capital requirements imposed under the Basle Accord, raised the capital requirements on U.S. banks= commercial and consumer loans and effectively lowered the capital requirements on U.S. banks= holdings of government securities. It also formally assigned capital requirements for various off-balance sheet activities. While the formal agreement only involved large (assets > $1 billion) international banks, U.S. regulators imposed the requirements on all domestic banks.

B. Bank Classifications

Data on asset quality and other accounting information is obtained from annual Call Reports for 1985 to 1992.[6] Asset quality is estimated for the year immediately prior to the first announcement concerning the Basle agreement or December 31, 1985. The ratio of non-accruing loans and leases to total loans serves as one proxy for the existing asset quality of each bank at the time of the first regulatory announcement. Whalen and Thomson (1988) find that this ratio is the key predictive ratio in a model of changes in bank financial condition. In forming portfolios for cross-sectional tests, each institution is ranked on asset quality and assigned to one of three groups; low, moderate and high. These rankings characterize the riskiness of the loan portfolio given the bank=s investment opportunities, management choice and ability and outcomes. All else equal, banks with high loan delinquency rates are riskier and have a higher probability of failure than banks with low loan delinquency rates. To the extent that loan delinquencies are an indication of the quality of loan opportunities, banks with better loan opportunities should have lower delinquency rates. I realize that all is not equal and that loan delinquencies may be high because management has chosen a risky portfolio or has realized bad outcomes.[7] Later I will use the market-to-book ratio to classify banks' loan opportunities.

A second proxy for asset quality is the ratio of risk-weighted assets to unweighted assets. This ratio corresponds to the bank's portfolio risk as measured by the risk-based capital (RBC) guidelines. Avery and Berger (1991) find that RBC relative risk weights were significantly related

[6] The formal name for the call report is the Federal Financial Institutions Examination Council's Consolidated Reports of Condition and Income.

7 I also performed the analysis using an alternative measure of loan quality: (net interest income – charge-offs)/total loans. This measure recognizes that banks may take higher risk loans that lead to higher charge-offs but also provide superior returns.

to several performance variables between 1982 and 1989, including bankruptcy. This implies that the RBC ratio may serve as an indicator of bank portfolio risk. In addition, this ratio tends to indicate exante risk-taking decisions whereas the loan delinquency ratio is more indicative of expost or realized risk.

I use both of the quality measures to classify banks in the pre-regulatory period. However, I believe that because banks in general will shift to the lower risk weighted assets after RBC requirements are imposed, the loan delinquency ratio will be a better measure of trends in risk-taking in the post-regulation period. Under the new regulatory regime, a shift toward lower risk assets does not mean that risk has fallen since within these risk classes banks may have incentives to undertake excessive risk, i.e. by reducing commercial loans and making riskier investments in securities or residential real estate.

C. Sample Banks

Information on individual bank assets, liabilities and income were obtained from Call Reports filed with the Federal Reserve Board from 1985 through 1992. More than 13,000 banks filed such reports in 1985. The sample was limited to domestic banks with assets in excess of $1 billion as of 12/31/85 and includes 311 banks. Because many of these were part of multi-bank holding companies there were actually only 111 publicly traded independent banks or bank holding companies. I use this sample because these large banks are more likely to have stock return data and because as Table 2 indicates, the majority of banking assets in 1985 (65%) were held by these large banks.

I also analyze the relationship between market measures of risk, abnormal returns and growth opportunities for a sample of large publicly traded bank holding companies. To be included in that analysis, a bank holding company must have a complete return series on CRSP over the period of analysis and at least $1 billion in assets. Financial data on holding companies is obtained

from Y-9 reports. In 1985, bank holding company Y-9s did not have detailed information about asset composition. Therefore, it is not possible to calculate risk-weighted assets using the Y-9 data. However, it is important to analyze holding company results because the capital requirements were imposed on both banks and bank holding companies. In addition, holding companies may have assets that are not part of the bank unit and these assets may be important determinants of market valuation.

Under risk-based capital, banks are required to hold tier1 capital consisting of common and perpetual preferred equity, plus minority interest in consolidated subsidiaries, less goodwill of at least 4% of risk-weighted assets. Total capital (tier1 plus tier 2) consisting of tier 1 plus other preferred and convertible equity, plus loan loss reserves (limited to 1.25% of risk-weighted assets) plus subordinated debt (limited to 50% of tier 1 capital) must be at least 8% of risk-weighted assets.[8] I used an approximation of the RBC requirement because the Call Reports prior to 1988 did not report all of the variables necessary to calculate risk-weighted assets. I find that the RBC standard was binding on 28 out of 107 (or 26%) of the large banks as of 12/31/85.[9] Combined, these banks held $0.8 trillion in assets or 27.7% of the $2.7 trillion in total banking assets in December of 1985. The RBC standard was also binding on smaller banks holding 10.7% of total banking assets. These statistics suggest that the standards were economically meaningful since they effectively constrained banks holding a significant amount (38%) of total banking assets.[10]

Stock return data is used to test several of the hypotheses. Therefore, the Call Report sample was matched with banks and bank holding companies found on CRSP tapes. In order to match

[8] Tier 2 capital cannot be larger than Tier 1 capital.

[9] Holding company capital ratios were constructed from individual bank Call Reports. Therefore they are a noisy measure of holding company capital. Nonetheless, the results on wealth effects for those holding companies where RBC was binding are striking.

[10] Under RBC, the ratio of tier1 capital-to-risk weighted assets ([common equity + perpetual preferred stock + minority interest in consolidated subsidiaries - goodwill]/risk weighted assets) must be no less than 4%.

the banks on CRSP with those in the Call Reports, Moody's Bank & Finance Industry Manual and company annual reports were reviewed.[11] The CRSP matched sample includes 107 banking firms with both Call Report and CRSP return information. The sample size changes through the pre- and post- announcement periods due to bank mergers and failures. The Y-9 sample was also matched with CRSP data holding company analysis and includes 176 firms.[12]

D. Interest Rate Spreads

I use the CRSP Macroeconomic series to obtain monthly data on 3 month treasury bill rates between 1947 and 1996, 3 month commercial paper rates between 1971 and 1996 and the prime rate charged by banks on short-term business loans between 1947 and 1996. In the time series analysis of these spreads, I use the FDIC Historical Statistics on Banking which contains annual data on national banking industry assets, loan charge-offs and equity between 1947 and 1996.

E. Methodology

In testing the wealth effects of any of the four regulatory announcements considered here, the estimation procedures must address several concerns. First, identification of the event date

[11] To be included in the sample a CRSP holding company had to control at least one bank with $1 billion or more in assets.

[12] A holding company must have $1 billion in assets to be included in this sample. There are more holding companies that meet the size criterion than there are banks. In future versions of this paper I will use call reports and Y-9s to analyze the same sample of banks.

may be imprecise because I am dealing with regulatory acts that progressed from committees of the Federal Reserve Board, FDIC and the Comptroller of the Currency over extensive periods of time. The event date should represent the date where new information was released and caused the market to change its expectations about the firm and/or industry. To the extent that the probability and potential effects of passage were continuously impounded in stock prices, the power of the tests may be low. This event date identification issue, with regard to regulatory changes is discussed in Schwert (1981). Brown and Warner (1980), simulate the effects of imprecise dating of the event, and show that the power of tests is greatly reduced.

I employ an event study methodology to measure shareholder wealth effects. The events are outlined in Table 2.[13] I calculate market model residuals throughout the event and estimation periods. Market model parameters are estimated over a 240 day period beginning 280 days prior to the event date. A bank must have returns for at least 120 days in that period in order to be included in the sample. Because all the firms in this study are in the same industry, the contemporaneous covariances among the abnormal returns of firms in the sample are nonzero. Firms in the same industry experience common unanticipated shocks [Schwert (1981)]. Therefore, tests using these abnormal returns will be misspecified. I control for cross-sectional dependence by using a test statistic that is based on a standard deviation estimated for the portfolio of sample firms from residual returns in the estimation period.[14] This test statistic which was developed by Jaffe (1974), is used in O'hara and Shaw (1990) in a banking industry event study. In order to test hypotheses regarding cross-sectional differences in abnormal returns, I perform difference in means tests across various portfolios using standard deviations of

13 Wagster (1996) includes several more events. I focus on events that provide major information on the design of risk-based capital requirements and not on the international negotiations.

[14] An alternative specification is a multivariate regression model [Binder (1985) and Smith, Bradley and Jarrell (1986)] which is an application of the more general seemingly unrelated regression model [Zellner (1962) and Theil (1971)]. This approach was not used here because the test-statistic is biased when there are a small number of data points relative to the number of variance-covariance terms (2 to 1 in this case). In addition, the gains in power from this approach are marginal. See Bernard (1987) for a discussion.

differences calculated from the pre- announcement period.

The market model was estimated for 240 days beginning 280 days prior to the first announcement date. That model is:

$$R_{it} = \alpha + B_1 R_{mt} + \varepsilon_t \qquad (1)$$

From the coefficient estimates, prediction errors are calculated. These cumulative prediction errors (CAPE) are tested for significance and also used in difference in means tests.

4. Hypotheses and Empirical Results

A. Cross-Sectional Differences at Announcement Date

1. Predictions

Here I describe each of the explanatory variables used to form portfolios used in the difference in means tests and explain how each should affect abnormal returns to bank shareholders under predictions of the underinvestment model, as well as the asset substitution and put option models.

Explanatory Variables in Cross-Sectional Analysis of the Basle Accord's Wealth Effects

$BIND_i$ = is a dummy variable that equals 1 if bank I does not meet the new risk-based capital requirements as of 12/31/85, and 0 otherwise.

$LOWQ_i$ = is a dummy variable that equals 1 if bank I is in the low quality sample and zero otherwise.

$MEDQ_i$ = is a dummy variable that equals 1 if bank I is in the medium quality sample and zero otherwise.

$HIGHQ_i$ = is a dummy variable that equals 1 if bank I is in the high quality sample and zero otherwise.

While the asset substitution theory does not make predictions regarding changes in shareholder wealth, both the put option and underinvestment models predict that on average, abnormal returns will be negative (CAPE< 0) upon the announcement of increased capital requirements because constraints generally impose costs. Under each theory, banks that do not meet the new standards should be more affected by the regulatory change than banks that do meet it. Capital deficient banks will need to raise new capital sooner. Therefore these banks are more adversely affected by the new capital requirements. If regulation is effective in restoring correct investment incentives for poor quality banks then negative abnormal returns should be greatest for the banks in the low quality sample. This is the prediction of the put option theory. On the other hand, the underinvestment theory predicts that the regulation may increase underinvestment incentives for banks with good loan opportunities and I should observe significant negative abnormal returns to banks with high loan quality.

2. Results

A. Shareholder Wealth

Market model residuals were calculated for the 107 firms in the sample. These results are presented in Table 3. The analysis was applied to the four regulatory announcements beginning with 1/16/86 for the full sample and each of three sub samples formed on both existing asset

quality and portfolio risk weights. For the full sample the cumulative average prediction error from days -5 to +5, CAPE(-5,+5), is -0.0325 which is significant at the 5% level of significance and CAPE(-1,+1) is -0.025 which is significant at the 1% level.

Table 4 reports the wealth effects for the three loan quality-based samples. The -0.087 CAPE(-5,+5) reported for the low quality sample is significant at the 1% level. The cumulative average prediction errors for the medium quality sample are insignificant. This indicates that the regulation was costly to bank shareholders on average with the most significant costs borne by shareholders of banks with low existing asset quality (i.e. higher probability of failure). I expect these banks to lose because increasing capital requirements forces their shareholders to bear more of the losses associated with making negative NPV investments. However, there appears to be some cost borne by shareholders of relatively high quality banks. These shareholders experienced a -0.0322 CAPE(-5,+5) which is marginally significant (at 10% level). The evidence of some negative wealth effects to shareholders of high quality banks is consistent with both the over/under- investment and put option predictions. It implies either high quality banks have significant opportunities subject to underinvestment and therefore lose under more restrictive capital requirements or that the value of their put option although initially low, still declined. If the latter were true I would also expect to find negative abnormal returns for medium quality banks but I do not.

Table 4b contains results from differences in means tests for each of the three samples. The difference in mean cumulative average prediction errors was significant for low versus medium quality banks. Again it appears that the most significant costs were borne by shareholders of low quality banks. There is no significant difference between mean cumulative average prediction errors for high and low quality firms. This evidence along with the slightly negative returns to high quality firms suggests that losses to low quality firms did not represent wealth transfers to high quality firms.

Table 5A reports wealth effects for a group formed on the basis of the ratio of risk-weighted to unweighted assets. A higher ratio implies a higher degree of risk. Recall that Avery and Berger (1991) find that this ratio is significantly related to several performance measures including bankruptcy. The high risk-weighted asset group reported the most significant losses. The CAPE(-5,+5) of -0.11833 is significant at the 1% level. The magnitude also appears to be economically significant. Results for the medium and low risk-weighted asset groups are not reported but were negative and insignificant. Table 5B reveals that the differences in means between the low vs. high RWA and medium vs. high risk-weighted asset groups are significant. The 11 day difference in means is .1093 and .0893 (both significant at 2.5%) for the low vs. high group, and medium vs. high groups, respectively. High quality banks with high risk-weighted assets had significantly negative cumulative average prediction errors of -5.59%, versus -14.5% and -10.8% for high risk-weighted asset banks with medium and low quality, respectively. The differences between high vs. low and medium vs. low are insignificant. These results indicate that the risk-based capital guidelines may have been viewed as a "tax" on investment in the high weight assets and not an increased cost of risk-taking. As a result, banks with large investments in these high weight assets and average or superior loan quality sustained wealth losses that were not significantly different from banks with very poor loan quality.

Table 6 reports cumulative average prediction errors and difference in mean cumulative average prediction errors across two portfolios of banks -- those where the risk-based capital requirements are binding at 12/31/85 and those where it was not binding. The sample of banks where the new risk-based capital was binding experienced significantly negative abnormal returns throughout the event period. The CAPE (-5,+5) is -0.1067 which is significant at the 1% level while banks where the requirement was not binding experienced negative but insignificant abnormal returns. The difference in means of -0.0932 is significant at the 2.5% level.

Overall, the evidence on wealth effects is consistent with the underinvestment and put

option theories. Both predict negative returns to shareholders. Losses were very significant for shareholders in firms that tend to have the most distorted investment incentives, i.e. firms with either high leverage or low asset quality. However, losses were also significant for banks with superior loan quality, especially those with relatively high risk weighted assets. This contradicts the put option theory which suggests that the riskiest banks (i.e. those with weak capital and poor loan quality) will face the heaviest penalty.

B. Investment Trends

Trends in quality and asset composition are consistent with either the underinvestment hypothesis or the put option analogy for the low quality sample and either underinvestment and asset substitution for the high quality sample. Banks with poor asset quality prior to the regulation experienced marginal improvement in quality over the period with bad loans falling from 2.0% of assets to 1.9%. At the same time, investment in C&I loans fell from 21% to 16% of total assets and in government securities rose from 12.5% to 19.7%.[15] Recall that both the over/under- investment and put option theories predict that these banks will reduce portfolio risk in response to increased capital requirements on C&I loans. It appears that asset quality did improve for this sample.

However, asset quality deteriorated for the sample of high quality banks. Bad loans grew to 1.5% from 0.4% of assets. Investment in C&I loans fell from 15.7% to 13.4% while investment in securities rose to 23% from 19.6%. This finding is consistent with the O/U-I model under an assumption of relatively high underinvestment costs for banks with better than average loan opportunities. Under higher capital requirements these high quality banks have relatively more low risk profitable C&I loan opportunities that will be rejected. The lower investment in low risk, profitable loans offsets any reduction in overinvestment thereby causing a decrease in asset

[15] These trends began before the recession of 1990-91 and therefore do not appear to be simply a result of economic conditions. The evidence on whether risk-based capital caused portfolio reallocation is mixed (see Berger and Udell (1994) and Hancock and Wilcox (1994) and Grenadier and Hall (1996).

quality.[16] These findings are also consistent with asset substitution. The high quality banks may have increased asset risk in order to offset the decline in risk caused by stricter capital requirements.

While the evidence is consistent with these two hypotheses I can not rule out alternative explanations for the trends in loan quality. For example, the high quality banks may have made these "bad loans" prior to the date of the asset quality classification or perhaps there is a tendency toward mean reversion in asset quality. Below I present formal cross-sectional analysis of these trends. This analysis provides some support for the contention that risk-based capital led to different risk-taking patterns for banks in low vs. high risk and leverage categories. Analysis of patterns of loan quality in a period without new capital regulation could also help determine if mean reversion in asset quality is common.

C. Cross-Sectional Differences in Risk-Taking in Post Risk-based Capital Era

I use the following dummy variables: binding RBC requirements $BIND_i$, high asset quality $HIGHQ_i$, and low asset quality LOW_i and the proxy for asset quality as the dependent variable to identify which model is consistent with the evidence. Similar regressions are performed using the change in relative C&I lending as a dependent variable. The underinvestment model predicts that banks with good asset quality prior to the new regulation will experience relatively more deterioration in asset quality on average and low quality banks will experience relatively less deterioration or improvement in credit quality on average in the post-regulation period. The put option model predicts that weakly capitalized and low quality banks should have

[16] In the limit, where the probability of bank failure is zero and there are no over- or under- investment incentives exante, increasing capital requirements will only increase underinvestment, thereby increasing portfolio risk.

the most significant relative improvement in quality. Asset substitution predicts that some banks will actually have deterioration in asset quality. The regression results are reported in Table 7.

1. Changes in Asset Quality

The change in the bad loan ratio was significantly related to each of the explanatory variables. The ratio declined more for banks with high bad loan ratios (e.g. low asset quality) prior to the regulation. The coefficient of -0.007 is significant at the 1% level. The ratio increased for banks with high quality prior to the regulation. The coefficient of 0.004 is significant at the 5% level of significance. Finally, the ratio increased for banks where RBC was binding. The coefficient of 0.007 is significant at the 1% level of significance. The latter result indicates that some asset substitution may have occurred among banks where RBC was binding. Overall, the evidence suggests that low quality banks had significantly improved asset quality in the post risk-based capital period while high quality banks experienced some deterioration in quality. This evidence is not consistent with the implications of the put option model.

2. Interest Rate Risk

I calculated changes in the absolute value of one and five year GAP between December 31, 1988 (the first year that this data is available on the Call Reports) and December 31,1992. GAP is the difference between short-term assets (assets repricing in less than one or five years) and short-term liabilities (liabilities repricing in less than one or five years). A bank with a negative GAP position, i.e. short-term liabilities in excess of short-term assets, is vulnerable to future increases in interest rates while a bank with a positive GAP position is vulnerable to future decreases in interest rates. By taking the absolute value of GAP I am measuring the magnitude and not the direction of the interest rate exposure. To control for differences in bank size I divide the

absolute value of GAP by total assets. Regression results shown in Table 7 reveal that pre- RBC leverage was significantly related to changes in interest rate exposure but pre- RBC loan quality was not. The change in interest rate exposure in both one and five year GAP was higher if the RBC requirement was binding and if the ratio of tier2 capital-to-RWA was lower. In the one year GAP regression the coefficient on the dummy variable BIND is 0.118 and is significant at 1% and in the five year GAP regression banks with higher total risk-based capital in 1985 had significantly lower changes in five year GAP on average. These findings are consistent with predictions of both the overinvestment model (lower capital requirements on government securities lead to higher investment) and the asset substitution model (banks increased interest rate risk perhaps to substitute for reduced leverage).

3. Market Measures of Risk

Tables 8 and 9 contain descriptive statistics on a sample of publicly traded bank holding companies. Y-9 reports were used to analyze changes in market measures of risk and abnormal returns for these banks upon the first announcement proposing risk-based capital standards. Our previous analysis suggests that changes in wealth and risk will depend on growth opportunities. Table 10 provides means on changes in risk and several control variables for bank holding companies divided into quartiles based on market-to-book ratios. Market-to-book is used to proxy for growth opportunities. Banks with the highest market-to-book ratios are generally smaller, have stronger asset quality and higher equity ratios. They also experience larger increases in residual variance following the first risk-based capital announcement. Table 11 contains regressions of changes in market measures of risk. Changes in residual variance are significantly

higher for banks with poor loan quality, very high market-to-book ratios and for smaller banks. The relationship between changes in return variance and growth opportunities is not linear. Further analysis of this data will be presented in the next version of this paper.

D. Bank Lending Rates

I analyze changes in one particular loan rate -- the prime lending rate. Table 12 contains regressions of the spread between the prime rate and 3 month treasury bill rates, the prime rate and 3 month commercial paper rates and the 3 month commercial paper rate and 3 month treasury bill rates. The prime rate is an index that is the basis of many consumer and corporate loans. Corporate borrowers with loans indexed to prime are typically not large corporations with access to public debt and equity markets. They are also not likely to issue commercial paper. Because these borrowers tend to be riskier than commercial paper issuers, the prime rate is typically higher than commercial paper rates. Commercial paper issuers tend to be high grade corporate borrowers. However, commercial paper is not free of default risk. Therefore, commercial paper rates tend to be higher than treasury bill rates.

The purpose of this analysis is to determine whether there was a significant change in bank lending rates relative to other money market rates after risk-based capital requirements were implemented. If on average, risk-based capital requirements increased the cost of capital for banks, we would expect banks to raise their lending rates to compensate for this change. Alternatively, banks may raise the prime lending rate if the perceived riskiness of the average borrower has increased and the additional compensation is required due to the additional risk. Therefore, a higher spread may result form a decision to lend to riskier customers. The spread

between prime and both the commercial paper and t-bill rates increased in the period after risk-based capital was implemented. This change is highly significant even after controlling for the recession of 1990-91 and bank capital. During the same period, the ratio of loan charge-offs to total assets declined significantly. Thus, it appears that the increase in spreads was not accompanied by an increase in average borrower risk. This evidence is consistent with an increase in the cost of capital for banks.

5. Conclusions

I examine the effect of risk-based capital requirements on shareholder wealth and bank risk. The empirical examination takes place in the context of three competing models regarding the effect of capital requirements on bank investment. As both the over-/under- investment and put option models predict, risk-based capital reduces shareholder wealth. The wealth effects were most significant for banks where the new requirements were binding and those that were more heavily invested in the high risk assets. Among banks with heavy investments in assets classified as Ahigh risk≅ under the new capital standards, there were significant losses to shareholders of banks in each of the subsamples formed on the basis of actual loan quality. Banks in the middle third of the quality subsamples had the most significant negative abnormal returns. Thus, it appears that Arisk-based≅ capital standards penalized banks with large investments in relatively moderate quality commercial and industrial loans.

The changes in actual loan quality after the new standards were imposed are also consistent with differential changes in underinvestment. Contrary to the prediction of the asset substitution theory, the asset quality in institutions' that had relatively high incentives for undertaking

excessive risk (i.e. banks with poor asset quality) improved. However, the asset quality of banks with good loan quality deteriorated in the post risk-based capital era. This finding is not consistent with the put option model. Finally, banks with low risk-based capital increased their interest rate risk exposure. This behavior is consistent with both the underinvestment and asset substitution theories. Overall, the asset substitution and put option models are only supported when they agree with the predictions of the underinvestment model.

Risk-based capital standards did impose costs on U.S. banks. Those costs were most significant for banks with large investments in assets qualified as "high risk" under the new standards. Within this group of banks, those with moderate risk (as measured by loan delinquencies) bore more cost than banks with either high or low risk. In other words, banks that made fairly good commercial and industrial loans lost the most. Risk-based capital also appears to have changed loan pricing. The spread between the prime rate and both commercial paper and treasury bills increased significantly. Additional robustness tests should be done before conclusions are drawn. I also will analyze changes in stock market measures of risk for bank holding companies. Finally, I will examine the behavior of loan quality during other time periods to see if there is generally mean reversion in bank asset quality.

References

Avery, R. and A. Berger, 1991, Risk-based capital and deposit insurance reform, *Journal of Banking and Finance* 15, 847-874.

Berger, A. and G. Udell, 1994, Did risk-based capital allocate bank credit and cause a credit crunch in the U.S.?, *Journal of Money, Credit and Banking* 26, 585-628.

Bernard, Victor, 1987, Cross-sectional dependence and problems in inference in market-based accounting research, *Journal of Accounting Research* 25, 1-48.

Binder, J., 1985, Measuring the effects of regulation with stock price data, *Rand Journal of Economics* 16, 167-183.

Brown, S. J. and J. B. Warner, 1980, Measuring security price performance, *Journal of Financial Economics* 8, 205-258.

Diamond, D., 1984, Financial intermediation and delegated monitoring, *Review of Economic Studies* 51, 393-414.

Eyssell, T. and N. Arshadi, 1990, The wealth effects of the risk-based capital requirement in banking, *Journal of Banking and Finance* 14, 179-197.

Furlong, F. T. and M. Keeley, 1989, Capital regulation and bank risk-taking: A note, *Journal of Banking and Finance* 13, 883-891.

Grenadier, S. and B. Hall, 1996, Risk-based capital standards and the riskiness of bank portfolios: Credit and factor risks, *Regional Science and Urban Economics* 26, 433-464.

Jaffe, J. F., 1974, Special information and insider trading, *Journal of Business* 47, 410-428.

James, C., 1987, Some evidence on the uniqueness of bank loans, *Journal of Financial Economics* 19, 217-235.

Kahane, Y., 1977, Capital adequacy and the regulation of financial intermediaries, *Journal of Banking and Finance* 2, 207-217.

Keeley, M., 1990, Deposit insurance, risk and market power in banking, *American Economic Review* 80, 1183-1200.

Keeley, M. and Furlong, F, 1990, A reexamination of mean-variance analysis of bank capital regulation, *Journal of Banking and Finance* 14, 69-84.

Kim, D. and A. Santomero, 1988, Risk in Banking and Capital Regulation, *Journal of Finance*, 43, 1219-1233.

Leland, H. and D. Pyle, 1977, Informational asymmetries, financial structure, and financial intermediation, *Journal of Finance* 32, 371-387.

Lummer, S. and J. McConnell, 1989, Further evidence on the bank lending process and the capital market response to bank loan agreements, *Journal of Financial Economics* 25, 99-122.

Marcus, A., 1984, Deregulation and bank financial policy, *Journal of Banking and Finance* 8, 557-565.

Merton, R. C., 1977, An analytic derivation of the cost of deposit insurance and loan guarantees, *Journal of Banking and Finance* 1, 3-11.

O'Hara, M. and W. Shaw, 1990, Deposit insurance and wealth effects: The value of being "too big to fail," *Journal of Finance* 45, 1587-1600.

Schwert, G. W., 1981, Using financial data to measure effects of regulation, *Journal of Law and Economics* 25, 121-145.

Sheshunoff, Alex, 1991, The bank quarterly ratings and analysis, *Sheshunoff Rating Services, Inc.* Austin.

Smith, R. T., M. Bradley and G. Jarrell, 1986, Studying firm-specific effects of regulation with stock market data: an application to oil price regulation, *Rand Journal of Economics* 17, 467-489.

Stanton, S. W., 1998, The underinvestment problem and patterns in bank lending, *Journal of Financial Intermediation* 7:3, 293-326.

Theil, H., 1971, *Principles of Econometrics*, John Wiley and Sons.

Wagster, J., 1996, Impact of the 1988 Basle Accord on International Banks, *Journal of Finance* 51:4, 1321-1346.

Whalen, G. and J. Thomson, 1988, Using financial data to identify changes in bank condition, *Federal Reserve Bank of Cleveland Economic Review* 24, 17-26.

Zellner, A., 1962, An efficient method of estimating seemingly unrelated regressions and tests for aggregations bias, *Journal of American Statistical Association* 57, 358-368.

Table 1. Distribution of Assets in all Banks (12/31/85)

	# of Banks	Avg. Assets ($MM)	Total Assets ($MM)	
Assets > $1,000MM	311	5,694.5	1,770,990	(65.2%)
$300MM<Assets< $1,000MM	504	509.5	256,788	(9.4%)
$0<Assets<$300MM	13531	51.0	690,081	(25.4%)
Total	14346	189.4	2,717,859	(100.0%)

Table 2. Announcements in Event Study

Announcement Date	Date of News Report	Announcement
1/16/86	Washington Post (1/15/86)	Federal Reserve Board issued for public comment a proposal intended to bring its policies on bank capital into better alignment with the risk profiles of the banking industry. Key words: Off-balance sheet exposures Remove disincentives to hold low risk, relatively liquid assets
1/8/87	WSJ & NYT (1/9/87)	U.S. bank regulatory agencies and the Bank of England agreed to request public comment on a proposed risk-based capital framework for banks and bank holding companies that was developed jointly by the OCC, FDIC, Federal Reserve Board and the Bank of England. Key words: Off-balance sheet exposures Moving policies of U.S. and other major industrial countries into closer alignment
12/11/87	WSJ & NYT (12/12/87)	U.S. bank regulators seek public comment on a proposed framework for risk-based capital that was developed jointly by authorities from 12 leading industrial countries. The press release is dated 12/10/87. Key words: Remove competitive inequity for banks arising from differences in national supervisory requirements
7/11/88	NYT & WSJ (7/12/88)	Announce final agreement on international convergence of capital requirements and standards as adopted by the Basle Committee on Banking Regulations. Actual report is dated 7/15/88.

Table 3. Daily and cumulative average prediction errors and t-stats for the RBC sample over all 4 events
(N=107)

Day	APE	T-Stat	CAPE	T-CAPE
-5	-0.01988	-3.62652	-0.01998	-3.62652
-4	0.00398	0.71908	-0.01600	-2.05586
-3	0.00087	0.11116	-0.01513	-1.61444
-2	-0.01119	-2.12356	-0.02632	-2.45993
-1	-0.01182	-2.19082	-0.03814	-3.17999
0	0.00354	0.68642	-0.03460	-2.62268
1	-0.01625	-3.00719	-0.05085	-3.56475
2	0.00796	1.39840	-0.04289	-2.84011
3	0.00417	0.80073	-0.03872	-2.41077
4	0.00133	0.13320	-0.03739	-2.24493
5	-0.00042	-0.11672	-0.03781	-2.17565

Table 4A. Daily and cumulative average prediction errors and t-stats for the low quality sample over all 4 sample events

Day	APE	T-Stat	CAPE	T-CAPE
-5	-0.02750	-4.07645	-0.02750	-4.07645
-4	0.00541	0.81242	-0.02209	-2.30802
-3	-0.01259	-1.91121	-0.03468	2.98793
-2	-0.01894	-2.82621	-0.05362	-4.00073
-1	-0.02000	-2.98063	-0.07362	-4.91134
0	0.00705	1.06923	-0.06657	-4.04691
1	-0.02595	-3.85649	-0.09252	-5.20432
2	0.00625	0.95598	-0.08627	-4.53021
3	0.00669	1.01405	-0.07958	-3.93310
4	0.00556	0.74464	-0.07402	-3.49580
5	-0.01300	-1.94738	-0.08702	-3.92027

Table 4B. Difference between cumulative average prediction errors for subsamples based on loan quality.

	Low vs. Medium	Low vs. High	Medium vs. High
CAPE (-5,+5)	0.09449***	0.05486	-0.03961

*, **, and *** indicates significance at the 5%, 2.5%, and 1% level respectively.

Table 5A. Daily and cumulative average prediction errors for the sample of high risk-weighted assets banks

(N=35)

Day	APE	T-Stat	CAPE	T-CAPE
-5	-0.03056	-4.41865	-0.03056	-4.41865
-4	0.00527	0.78183	-0.02529	-2.57163
-3	-0.01536	-2.23316	-0.04065	-3.38903
-2	-0.02868	-4.14811	-0.06933	-5.00904
-1	-0.01962	-2.84415	-0.08895	-5.75217
0	0.00130	0.21923	-0.08765	-5.16149
1	-0.03945	-5.70660	-0.12710	-6.93550
2	0.00763	1.12105	-0.11947	-6.09122
3	0.00916	1.33250	-0.11031	-5.29868
4	0.00773	1.02283	-0.10258	-4.70332
5	-0.01575	-2.28310	-0.11833	-5.17283

Table 5B. Difference between cumulative average prediction errors for subsamples based on risk-weighted assets.

	Low vs. Medium	Low vs. High	Medium vs. High
CAPE (-5,+5)	0.0199	0.10932**	0.0893**

*, **, and *** indicates significance at the 5%, 2.5%, and 1% level respectively.

Table 6. Differences in mean prediction errors for binding vs. non-binding samples of banks

Day	Binding (N=28)	Non-Binding (N=79)	Difference
-5	-0.03664***	-0.01192**	-0.02472*
-4	-0.00752	0.00801	-0.01554
-3	-0.02269***	0.00391	-0.02661**
-2	-0.02234***	-0.00527	-0.01706
-1	-0.01555**	-0.01241	-0.00315
0	-0.00230	0.00604	-0.00834
1	-0.03102***	-0.01055*	-0.02047
2	0.02404***	0.00678	0.01726
3	0.00541	0.00152	0.00389
4	0.00630	0.00175	0.00457
5	-0.00442	-0.00138	-0.00304
CAPE(-5,+5)	-0.10673***	-0.01352	-0.09321**

*, **, and *** indicates significance at the 5%, 2.5%, and 1% level respectively.

Table 7. Multiple Regression Results

$$Yi = b_o + b_1BIND_i + b_2HIGHQ_i + b_3LOWQ_i + e_i$$

Or

$$Yi = b_o + b_1BADRAT_i + b_2T2RWA_i + e_i$$

Y_i is either 1) the change in the ratio of non-accruing loans-to-total loans (♠BADRAT) between 12/31/85 and 12/31/92; or 2) the change in the ratio of commercial and industrial loans-to-total loans (♠C&IRAT) between 12/31/85 and 12/31/92; or 3) the change in the ratio of the absolute value of 1 year GAP-to-total assets (♠1YRGAP) between 12/31/87 and 12/31/92; or 4) the change in the ratio of the absolute value of 5 year GAP-to-total assets (♠5YRGAP) between 12/31/87 and 12/31/92. $BIND_i$ is a dummy variable with a value of 1 if risk-based capital requirements are binding on bank i on 12/31/85. $HIGHQ_i$ is a dummy variable with a value of 1 if bank i is in the highest of 3 loan quality subsamples based on non-accruing and past due loans on 12/31/85. $LOWQ_i$ is a dummy variable with a value of 1 if bank i is in the lowest of 3 loan quality subsamples based on non-accruing loans on 12/31/85. $BADRAT_i$ is the ratio of non-accruing loans-to-total loans for bank i on 12/31/85. $T2RWA_i$ is the ratio of total capital-to-risk weighted assets for bank i on 12/31/85. T-statistics are in parentheses.

Y_i	Intercept	BIND	HIGHQ	LOWQ	BADRAT	T2RWA	R^2
	0.006	0.002	0.004	-0.006			
ΔBADRAT	(4.031)	(0.776)	(1.780)	(-2.814)			7.3%
	0.018				-0.790	-0.054	
ΔBADRAT	(4.725)				(-6.365)	(-1.661)	15.0%
	-0.044	0.007	0.023	-0.004			
ΔC&IRAT	(-4.622)	(0.535)	(1.831)	(-0.284)			.9%
	-0.002				-2.134	-0.185	
ΔC&IRAT	(-0.088)				(-2.654)	(-0.829)	2.3%
	-0.004	0.118	-0.035	0.038			
Δ1YR GAP	(-0.192)	(2.409)	(-1.127)	(0.990)			7.9%
	0.197				-0.126	-1.859	
Δ1YR GAP	(3.174)				(-0.078)	(-3.451)	11.3%
	-0.025	0.056	-0.039	0.063			
Δ5YR GAP	(-0.982)	(1.041)	(-1.150)	(1.496)			5.1%
	0.196				1.254	-2.143	
Δ5YR GAP	(3.001)				(0.739)	(-3.791)	15.4%

Table 8: Descriptive Statistics (12/31/85)

Selected descriptive statistics for publicly traded bank holding companies with at least $1 billion in total consolidated assets.

Variable	Mean	Std Deviation	Min	Max	N
Market/Book	1.020	0.0321	0.948	1.205	176
Equity/Assets	0.063	0.014	0.038	0.145	176
Bad loans-to-Equity	0.214	0.156	0.017	0.863	176
Tot. Assets ($billions)	5.813	10.660	1.019	118.5	176
ΔTotal Stock Return Var.	.014%	0.040%	-0.068%	0.373%	176
ΔResidual Variance	.012%	0.040%	-0.067%	0.369%	176
ΔBeta	0.182	0.371	-1.798	1.163	176

Table 9: Correlation Matrix

Selected correlations for publicly traded bank holding companies with at least $1 billion in total consolidated assets.

Variable	Return Variance	Residual Variance	Equity/ Assets	Bad loans/ Equity	Log Assets	Market/ Book	ΔStock Variance	ΔResidual Variance
Return Variance	1.000***							
Residual Variance	0.538***	1.000***						
Equity/Assets	-0.171**	-0.147**	1.000***					
Bad loans/Equity	0.586***	0.412***	-0.462***	1.000***				
Log Assets	-0.076	-0.256***	-0.280***	0.198***	1.000***			
Market/Book	-0.095	0.173**	0.203***	-0.410***	-0.214***	1.000***		
ΔStock Variance	0.995***	0.453***	-0.169**	0.571***	-0.050	-0.116	1.000***	
ΔResidual Variance	0.786***	0.461***	-0.271***	0.449***	-0.001	0.050	0.794***	1.000***

Table 10: Mean characteristics of bank holding companies ranked by market-to-book ratios on 12/31/85

Means of selected variables for publicly traded bank holding companies with at least $1 billion in total consolidated assets. Holding companies are grouped by market-to-book quartiles.

Variable	Market-to-Book (1st)	Market-to-Book (2nd)	Market-to-Book (3rd)	Market-to-Book (4th)	Kruskal-Wallis Test
Equity/Assets	6.100%	6.037%	6.329%	6.844%	0.0000
Bad loans/Equity	37.49%	20.58%	16.81%	12.45%	0.0000
Assets ($Bil)	10.094	4.751	4.513	3.044	0.0883
Market/Book	0.986	1.010	1.027	1.061	0.0000
ΔStock Variance	0.0170%	0.0110%	0.0087%	0.0080%	0.1936
ΔResidual Variance	0.0004%	-0.0000%	0.0001%	0.0016%	0.0404

Table 11: Regressions of changes in return variance pre- and post- first risk-based capital announcement.

Regressions of either changes in daily total stock return variance or daily market model residual variance in the year prior to and after the January 16, 1986 risk-based capital announcement on selected bank holding company characteristics at December 31, 1985. BADEQ is past loans dues scaled by total equity. EQUITY is the ratio of equity to assets. MKTBOOK is the ratio of the holding company's market value (market value of equity plus book value of debt) to book value of assets. Regional dummies for holding company headquarters are included but not reported. LNSIZE is the natural logarithm of total assets. Standard errors are reported in parentheses.

Dependent Variable	Intercept	EQUITY	BADEQ	LNSIZE	MKTBOOK	MKTBOOK^2	Adj. R^2	No. of Obs.
ΔStock Variance	0.0246**	0.0088	0.0006***	-0.0004	-0.0450**	0.0210**	16.9%	174
	(0.0058))	(0.0117)	(0.0010)	(0.0001)	(0.0046)			
ΔStock Variance	0.0009	0.0011	0.0008***	-0.0000	-0.0003		15.4%	174
	(0.0013)	(0.0024)	(0.0002)	(0.0000)	(0.0010)			
ΔResidual Variance	0.0264	0.0007	0.0006***	-0.0000*	-0.0483**	0.0226**	17.8%	174
	(0.0118)	(0.0024)	(0.0002)	(0.0000)	(0.0220)	(0.0103)		
ΔResidual Variance	0.0008	0.0010	0.0008***	-0.0001*	-0.0002		16.0%	174
	(0.0012)	(0.0024)	(0.0002)	(0.0000)	(0.0010)			

*** {**} (*) Statistically different from zero at the 1% {5%} (10%) significance level.

Table 12: Regressions of abnormal returns upon the first risk-based capital announcement.

Regressions of abnormal returns (estimated from a market model) for the day before and of the January 16, 1986 risk-based capital announcement on selected bank holding company characteristics at December 31, 1985. BADEQ is past due loans scaled by total equity. EQUITY is the ratio of equity to assets. MKTBOOK is the ratio of the holding company's market value (market value of equity plus book value of debt) to book value of assets. LOWCAP is a dummy variable that equals one if the holding company's equity ratio is in the bottom quartile. Regional dummies for holding company headquarters are included but not reported. LNSIZE is the natural logarithm of total assets. Standard errors are reported in parentheses.

Dependent Variable	Intercept	EQUITY	BADEQ	LNSIZE	MKTBOOK	LOWCAP	Adj. R^2	No. of Obs.
Abnormal Return	0.4048***	0.1559	-0.0237	-0.0026	-0.3625***		11.5%	174
	(0.0866)	(0.1671)	(0.0165)	(0.0023)	(0.0710)			
Abnormal Return	0.4355***	-0.0523	-0.0174	-0.0029	-0.3737***	-0.0128**	13.7%	174
	(0.0865)	(0.1881)	(0.0165)	(0.0023)	(0.0703)	(0.0055)		

*** {**} (*) Statistically different from zero at the 1% {5%} (10%) significance level.

Table 13: Time series regressions of interest rate spreads on risk-based capital

The dependent variable is either the spread between the prime rate and the commercial paper rate or the spread between the prime rate and the treasury bill rate. REC is a dummy variable with a value of 1 during NBER recessions. RBC is a dummy variable with a value of 1 for periods after December 1991 when risk-based capital standards were imposed. CHGOFF is the ratio of loan charge-offs to total assets in the banking industry in that year. CAP is the ratio of total capital to assets in the banking industry in that year. The time periods analyzed are 1948-1996 (T=48 years) and 1971-1996 (T=24 years). Standard errors are reported in parentheses.

Dependent Variable	Intercept	REC	RBC	REC*CAP	CAP	CHGOFF	Adj. R^2	No. of Obs.
Prime-CP	1.479***	1.175***	1.209***				32.2%	300
	(0.056)	(0.133)	(0.125)					
Prime-Tbill	2.224***	1.524***	0.817***				28.5%	300
	(0.063)	(0.148)	(0.140)					
Prime-CP	3.116	21.795***	1.459**	-340.96***	-33.184	132.26***	57.9%	24
	(2.204)	(5.615)	(0.684)	(90.95)	(36.356)	(47.420)		
Prime-Tbill	5.145***	12.178**	1.554***	-178.25**	-54.45***	137.14***	55.1%	48
	(1.267)	(5.15)	(0.4762)	(81.07)	(17.82)	(52.18)		

*** {**} (*) Statistically different from zero at the 1% {5%} (10%) significance level.