Using Loan Rates to Measure and Regulate Bank Risk: Findings and an Immodest Proposal [*]

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July 31, 2002

Abstract

As simple portfolio theory would predict, we find that the interest rates charged on Commercial & Industrial (C&I) loans are good proxy for loan risk. Given loan rates, the internal risk ratings banks have been reporting since 1997 provide little extra information about future performance and CAMEL downgrades. In light of these findings, we suggest that bank supervisors consider using loan rates in their off-site surveillance of banks, and that regulatory reformers consider tying capital charges and insurance premia on loan interest rates instead of (or in addition to) internal risk ratings and models.

JEL Codes: G12, G21, G28, E43

Keywords: deposit insurance reform, credit risk pricing, and risk-based capital regulation

[*] Preliminary and incomplete. We thank Bill English, Fred Herriman, Kevin Stiroh, Joao Santos, Til Schuermann, and Cara Lown for their constructive comments and Shana Wang for research assistance. Any remaining errors in the paper are our own, and the views represented here reflect those of the authors and not those of the Federal Reserve Bank of New York or the Federal Reserve System.

Introduction.

Economists and bank regulators mostly support the idea of risk-based capital requirements and deposit insurance pricing, but there is significant disagreement on how to implement risk-based regulations. The Basle Committee on Capital Reform seems stymied. First they proposed the use of ratings from credit agencies, but that met criticism. Reformers came back with the proposal to let banks use their own models to measurement models, but that suggestion was tabled over concerns about model reliability and verifiability. Each round of battering forces the bruised reformers to postpone a final proposal, as they take time to think again. "Better" is fighting with "good" in this debate, and the longer it drags out, the greater the chance that the worst outcome will prevail -- no change, or a risk-based regulatory system that is too complicated to enforce.

This paper is not intended to criticize reformers, but to propose a simple alternative: *rate-based* regulation. Instead of basing capital requirements and insurance on the risk estimates reported by lenders, tie them to the interest rates actually charged on the loans. The idea is motivated by basic portfolio or loan pricing theory; the interest spread on a loan should reflect the underlying risk of default, so why not use the spread as a risk proxy? The obvious advantage of rate-based regulation over risk-based regulation is that loan rates are easily verifiable by outsiders, while the internal models that banks use to measure risk are not. Incentives to game a system of game a system of rate-based regulations should be minimal; to effect an (undeserved) reduction in its capital or insurance charges, a bank would have to lower the rate it charges for loans of given risk, and that is not likely to increase expected profits.[1] Rate-based regulations would naturally accommodate banks' use of collateral and other non-price loan terms. To the extent such terms translate into lower risk, and thus lower rates, rate-based capital charges and/or premiums would and should be lower.[2] Finally, the use of portfolio interest rates would naturally permit banks to take advantage of

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[1] Under the current *Basel Accord* and proposed revisions, banks are able to reduce capital requirements without actually reducing underlying asset risk and are able to increase asset risk without increasing capital.

[2] It would not be hard to incorporate commitment fees into the rate-based scheme.

the benefits of diversification (or incur the costs of concentration), a feature that addresses a long-standing criticism of the risk-based capital framework.

The first and most obvious question is whether the credit risk on bank loan is in fact reflected in the loan rate.[3] We find evidence that it is, even using the slightly mismatched data available to us. *The Survey of Terms of Bank Lending* (STBL) provides interest rates and other terms on the flow of new C&I loan extensions every quarter by approximately 300 U.S. banks; virtually all of the big banks and a sample of medium and small banks. C&I loan performance for each bank is measured using the stock measures available from banks' *Call Reports of Income and Condition*. Our data run from 1984 to 2001. Despite the stock-flow mismatch, we find that higher loan rates predict higher rates of past-due loans one-to-four quarters later. Banks with higher rate loans are also more likely to have their CAMEL rating downgraded by regulators, even after controlling for roughly a dozen other variables used in supervisors' offsite supervisory (SEER) model. Differences in loan rates both within banks and across banks are informative, but given loan rates, the internal risk ratings banks have been reporting in the STBL since 1997 are *not* informative, and neither are most of the other non-price terms reported in the STBL. Loan rates seem like a reasonable, possibly sufficient statistic, for bank risk, so why not use them more in bank supervision and regulation? We return to that question later, but first develop a simple framework through which to evaluate the impact of different regulatory regimes. After we reviewing the (scant) evidence on bank loan pricing, we discuss our main findings.

Theory.

We sketch a simple model in order to emphasize a few fundamental points. First, the under-pricing of deposit insurance creates incentives for banks to undertake excessive risk and leverage. Second, either the risk-pricing of deposit insurance or a risk-based capital requirement could fix these incentives when risk choice is observed by the regulator. Third, when risk choice is private information, banks will have every incentive to mis-represent actual risk choice to the regulator in order to reduce their capital requirements and/or

[3] The answer is not obvious. Though commonplace in bond markets, risk-based pricing of loans is said to be a relatively recent phenomenon in the banking business (Greenspan 1994).

deposit insurance premiums. Finally, while risk choice might not be observed directly by the regulators, in principle it can be credibly revealed to the regulator through the portfolio interest rate.

Basic Framework

Consider a bank that exists for three periods. At time t=1, the bank finances one dollar of assets using both insured deposits **d** and equity **e** so that **e+d = 1**. We assume there is a frontier **R(x)** which describes the efficient trade-off between the time 3 value of assets **R** and the time 2 choice of the probability the bank survives **x**. Along this frontier, the portfolio has value **R(x)** with probability **x**, and with probability **(1-x)** it has value zero, where **R** is decreasing in **x**.[4] The choice of loan portfolios **(x,R)** is consequently constrained by the inequalities $\mathbf{R(x) \geq R \Leftrightarrow x(R) \geq x}$, and the frontier is illustrated in Figure 1.

At time t=3, uncertainty over the value of assets is realized and all parties receive payoffs. In the good state, depositors are paid $\mathbf{R_d d}$ and the bank receives any residual cash flows. Reflecting the current regulatory regime, we assume that $\mathbf{R_d}$ is simply the risk-free rate of interest $\mathbf{R_f}$ which implies that the deposit insurance premium is zero. In the bad state neither party receives any cash flows and the bank fails. For simplicity, all parties are risk-neutral. The net value of bank equity can be written,[5]

$$\text{(1)} \qquad \mathbf{V = x[R-R_f d]-(1-d)R_f}$$

Note immediately that the bank will choose a combination of risk **x** and return **R** from the efficient frontier as the net value of equity is increasing in **x** holding constant the portfolio interest rate **R**. The bank wants to maximize the probability of survival **x** given return **R**, which is done by choosing a portfolio from the schedule **R(x)**.

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[4] We place few other restrictions on the form of R(x). In order for the first-order conditions to characterize the solution to the bank's maximization problem, we must assume $2\delta R/\delta x + x\delta^2 R/\delta x^2 < 0$.

[5] As all cash flows occur at time 3, there is no need for discounting when characterizing optimal bank choice of risk and leverage. Assuming that bank assets have no value in the bad state is made for simplicity and is not important. If leverage **d** has an independent effect on the probability of survival **x**, then the problem becomes a bit more complicated and it is possible for leverage requirements not to bind. We ignore this complication here.

The first-order conditions describing optimal choice of risk **x** at time 2 can be written,

$$\textbf{(2)} \qquad dV/dx = (R-R_f d)+x(dR/dx) = 0$$

Here the marginal value of increasing the probability of survival **x** to the net value of equity is reduced by leverage **d**, implying that leverage induces the bank to assume excessive risk. The under-pricing of deposit insurance by the insurer also creates a distortion as illustrated by the first-order conditions describing optimal choice of leverage **d** at time 1,

$$\textbf{(3)} \qquad dV/dd = R_f(1-x) \geq 0$$

Clearly, the bank will seek to maximize the time 1 choice of leverage **d** as long as there is a positive probability of default. As Equation (2) indicates, an increase in leverage further reduces the return to safe assets, inducing the bank to assume even greater risk.

Regulatory Regimes

If instead the regulator set a risk-based deposit insurance premium, the cost of deposits $\mathbf{R_d}$ will be equal to $\mathbf{R_f/x}$. The new objective function is simply,

$$\textbf{(4)} \qquad V = xR-R_f$$

and the equivalent of the first-order conditions in Equation (2) would indicate that the net value of equity no longer depends on leverage. Moreover, this efficient choice of risk would maximize the value of assets.

These points are illustrated in Figure 1, where $\mathbf{V^0}$ corresponds to the iso-“net value of equity” curve in the absence of regulation and $\mathbf{V^*}$ in the presence of risk-priced deposit insurance. The under-pricing of deposit insurance flattens out the slope of the iso-“net value of equity” curve, inducing the bank to assume more risk by reducing **x** in order to increase the good state return **R**.

Alternatively consider a risk-based capital requirement that puts an upper bound on leverage so that **d(x) ³ d**. As this leverage requirement binds, the bank can no longer choose risk **x** and leverage **d** separately. First-order conditions with respect to the choice of risk now imply,

$$\text{(5)} \qquad dV/dx = R+x(dR/dx)+R_f[(1-x)(dd/dx)-d]$$

The last term of Equation (5) illustrates that binding risk-based capital requirements affect risk choice relative to the efficient risk choice in two ways. An increase in the probability of survival **x** reduces the opportunity cost of equity by $R_f dd/dx$ and decreases the expected time 2 value of equity by $R_f[d+x dd/dx]$. Note that when $d(x) = c/(1-x)$, these two incentives are offset perfectly, implying that the bank will choose risk to maximize the value of assets. With this form of regulation, the regulator can choose **c** so that each bank meets a target level of leverage but makes first-best risk choice.

Gaming of regulation by banks

A natural problem for regulators is that the choice of risk **x** is not observed, implying that it is quite difficult to enforce risk-based capital standards or write risk-based deposit insurance premiums. Consider the possibility that banks can report risk level x^{rep} to regulators independently of their actual risk choice **x**. As the bank has an incentive to maximize leverage in absence of regulation, it will have every incentive to exaggerate x^{rep} in order to reduce its capital requirement. This is of course quite similar to tying capital requirements to the risk choice revealed by internal risk ratings as proposed in the *Revised Basle Accord*.

On the other hand, while bank regulators might not directly observe the actual choice of risk **x**, they do observe the portfolio interest rate **R**. By its nature, the interest rate is contractible and could be used to set deposit insurance premiums or risk-based capital requirements. As long as the efficient trade-off between risk and return **R(x)** can be observed by regulators, the nominal interest rate on the bank's asset portfolio is a sufficient statistic for the choice of risk. This implies that the regulator can set risk-based capital standards or risk-priced deposit insurance using the inferred value of **x** through portfolio interest rates, either of which completely eliminate incentives for excessive leverage and risk-taking.

To make this point clear, re-consider a risk-based deposit insurance scheme. The cost of deposits is $\mathbf{r_d = r_f / x^{hat}(R)}$, where $\mathbf{x^{hat}(R)}$ is the regulator's mapping from the portfolio interest rate to survival probability. The marginal effect of **x** on the net value of equity is now,

$$\text{(6)} \qquad \mathbf{dV/dx = R + x(dR/dx) + d^*R_f[e_R^{hat}/e_R - 1]/x^{hat}}.$$

Here $\mathbf{e_R^{hat}}$ is the elasticity of predicted survival probability $\mathbf{x^{hat}}$ to **R,** and is a measure of how sensitive the insurance premium is to portfolio interest rate**.** On the other hand, $\mathbf{e_R\ (< 0)}$ is the elasticity of the survival probability to the portfolio interest rate defined by the efficient frontier. Note that the incentives for first-best risk choice exist when $\mathbf{e_R^{hat} = e_R}$**,** which implies that the elasticity of the cost of deposits $\mathbf{r_d}$ to the portfolio interest rate should be $\mathbf{-e_R}$ in order to eliminate incentives for excessive risk-taking. Moreover, as long as the elasticity of the cost of deposits is at least as large as $\mathbf{(1-x^{hat})e_R}$**,** the introduction of a risk-based deposit insurance premium reduces risk relative to a regime of zero-cost deposit insurance. This latter result is important because it implies that the deposit insurance premium does not have to be very sensitive to risk in order to reduce existing incentives for excessive risk-taking since the expected probability of default $\mathbf{(1-x^{hat})}$ is quite small.

The crucial element here that is missing in the current regulatory regime is an unbreakable mapping from risk to a regulatory instrument. In particular, the only way an expected profit-maximizing bank will assume more risk on a loan is through an increase in the stated interest rate. This implies that unlike the current or *Revised Basle Accord*, the implementation of either *interest-rate based capital requirements* or *interest-rate based pricing of deposit insurance* has the potential to actually fix underlying the agency problems that motivate a need for bank regulation in the first place.

Challenges for Applied Work

While the theory indicates that bank loan portfolios with higher interest rates should be more risky, we acknowledge the possibility of other confounding factors in the real world. For example, consider two banks that face different efficient frontiers as in Figure 2. A parallel shift up in the frontier across banks or over time will not affect the choice of risk, but does create noise in our mapping from interest rates to risk.

For example, one potentially confounding factor is the general level of interest rates in the economy, which shift the efficient frontier up and down with the risk-free rate of interest. As the analysis below uses panel data, we control for the general level of interest rates with a full set of time fixed effects so that the loan portfolio interest rates are implicitly spreads over the average interest rate charged on C&I loans.

Another potential problem is the presence of market power by banks in lending. While Strahan (2002) finds no evidence that loan prices are correlated with either state or local area Herfindahl-Hirshman indicies, there is a large literature built around the presumption that banks provide special services to borrowers and consequently have some market power. In order to deal with fixed differences across banks that shift up or down the efficient frontier of loan opportunities, we also employ bank fixed effects in several of the specifications below. In these regressions, the question is no longer whether or not banks with higher interest rates appear to have a more risky loan portfolio, but rather whether or not banks that are increasing their portfolio interest rates appear to be increasing the risk of their loan portfolio. This bank fixed effect should not only control for fixed differences in market power across banks, but also help control for other unobserved factors that would affect the position of the efficient frontier across banks.

The Little We Know About Bank Loan Pricing

The scarcity of facts about bank loan pricing reflects the dearth of data on bank loan rates and defaults. Bank loans are essentially private contracts between the bank and borrower, and the rates they negotiate are not public information. Loan defaults are not easily defined either, as default events include the merely technical violations of covenants to more serious missing of payments. Differences in the non-price terms of lending (collateral, covenants, etc.) also complicate comparisons across loans.

The little we do know about loan pricing is from Loan Pricing Corp., a private vendor that collects terms on syndicated loan deals between banks and large, corporate borrowers. Strahan's (1993) study of with LPC investigates the link between loan spreads and about a dozen proxies for firm risk.[6] Most variables are significant in explaining spreads, and in a given year, roughly two-thirds in the variation in all-in-spreads (including fees) on loans drawn under commitments is explainable by variation in these variables, with slightly lower percentages for spreads on undrawn commitments and term loans. Higher rate deals also tended to be secured, suggesting that banks try to mitigate the risk of lending to riskier borrowers by imposing tighter non-price terms. LPC does not follow the deals after origination, so he could test if loan spreads predicted actual loan performance.

Altman and Suggitt (2000) find that default patterns on syndicated loans to large, corporate borrowers are very similar to those for corporate bonds, except bank loan defaults are relatively accelerated with higher default rates over the first two years of the loan's life. They did not investigate whether the contractual interest rates on the loan predicted default probabilities.

Is Future Loan Portfolio Performance Predicted by Current Loan Rates?

Our first set of results uses confidential bank-level data from the *Survey of Terms of Business Lending (STBL)* and the *Call Report of Income and Condition.* We first describe each of these data sources in detail and then proceed to the analysis.

STBL. The micro-data from the *Survey of Terms of Business Lending* are generated from a quarterly survey of approximately 300 banks. The frequency distribution since 1984 is

[6] Strahan's (1993) risk proxies are size, earnings, leverage, capitalized lease obligations, market-to-book value, security, interest coverage, whether the firms' have bond ratings, whether the rating is investment grade, tangible assets, sales, and liquidity,

described in Table 1.[7] The survey covers all commercial and industrial loans and commitments of at least $1,000 made to US addresses during the first full business week for each of February, May, August, and November. Since we do not have performance measures at the loan level, it is necessary to aggregate all of the loans made during the survey week in order to create a portfolio of new bank loans. Weighting by the size of each loan, we construct a portfolio average for each of the loan interest rate, loan maturity, a dummy variable for the loan being secured, a dummy variable for a small loan (face value less than $250,000), and when appropriate the internal risk rating.

The mean portfolio interest rate over the time period is 9.35 percent with a standard deviation of 2.14 percent. Figure 3 illustrates its mean over time, and it appears that changes in these portfolio rates typically track changes in the federal funds rate over time. Figure 4 illustrates three cross-sections of the distribution of portfolio interest rates. Over time the probability mass has become more concentrated around the mean. The behavior of average non-price loan terms is displayed in Figure 5. There are clear trends in the average fraction of portfolios secured, the average portfolio maturity, and the average portfolio risk rating.

Call Reports. The main constraint when using the Call Reports is that information about non-performing commercial and industrial (C&I) loans from Schedule RC-N and C&I loan charge-offs and recoveries from Schedule RI is only available back to 1984. Time series for non-performing loans have been corrected for differences in reporting firms across banks and over time in to construct consistent time series. Similar corrections are made to create a time series for bank securities holdings. We emphasize that the provision data covers all loans, as a finer data series is not collected. Data for each of loan provisions and charge-offs from Schedule RI has transformed from its year-to-date reporting form to create a meaningful quarterly time series. It is also important to note that commercial and industrial loans 30 days past due are considered confidential and are not reported in the public version of the Call Reports available from the Federal Reserve Bank of Chicago. We thus limit our analysis to the population of insured commercial banks chartered in the United States 1984:I-2001:IV.

[7] In principle the microdata is available since 1976, but the inability to measures of loan performance in Call Reports before 1984 forces us to discard the earlier data.

Results

Tables 2, 3, and 4 report the results from a regression of each loan performance variable – non-performing loans, charge-offs, and provisions -- on four lags of the portfolio interest rate and in a second specification adding four lags of C&I loan growth as a proxy for loan demand. We emphasize that every regression below includes a full set of time fixed effects. Each of the four regressions includes time effects and standard errors are corrected for heteroskedasticity. In the first to columns of each table, standard errors have been clustered at the bank level to account for dependence in the residuals within a bank over time. On the other hand, the final two regressions include bank fixed effects and thus do not use clustering.

Coefficients from the first two columns of Table 2 indicate that current loan portfolio interest rates are very significant in predicting future loan performance. When comparing across banks, increasing the portfolio interest rate by one percentage point will increase non-performing C&I loans by almost one percentage point next quarter. This effect tends to drop off in subsequent quarters, but is still large and highly significant after four quarters at 60 basis points. When comparing the behavior of the same bank over time using the fixed effects specifications in the final two columns, the effects are smaller but remain statistically and economically significant.

An interesting fact to jump out of the second specification in each of columns (2) and (4) is that strong C&I loan growth tends to correspond to favorable future loan performance. This result seems at odds with the conventional wisdom that aggressive lending by banks – although note here we are holding constant the portfolio interest rate – is a sign of future trouble.[8]

Tables 3 and 4 highlight much weaker relationships between loan interest rates and each of charge-offs and provisions. These results are not particularly strong statistically, but we report them for completeness and note that banks have the ability (albeit limited by the regulators) to smooth both charge-offs and provisions over time.

Do Loan Rates Predict Supervisory Rating Downgrades?

There is evidence above that the portfolio interest rate and change in portfolio interest rate (fixed effect specifications) predict future loan performance, which implies that it might be useful in the off-site surveillance of banks or in the assessment of risk in a bank's commercial loan portfolio. Following this line of thought, we consider whether or not the information contained in a bank's portfolio interest rate can be used to forecast downgrades in bank health as measured by its CAMEL rating.

The supervisory rating data become available starting in 1985, but do not appear to cover the whole sample of STBL-reporting banks until 1987. We construct a data set that contains a bank's most recent CAMEL rating as of March and then attempt to forecast downgrades from CAMEL ratings of 1 or 2 to 3, 4, or 5 over the following year. As the most recent data that would have been available in March for forecasting is from the previous quarter, we only use December data from the *Call Reports* and November data from *STBL*.

The sample used in this analysis is described in Table 5. The first column corresponds to year prior to the measurement of a banks most recent CAMEL rating in March (in year+1), and is used to match to the other sources of data. The next three columns describe STBL-reporting banks that had CAMEL ratings of 1 or 2 as of that that March. Columns (2) and (3) break out number of these banks that were either not-downgraded or downgraded to CAMEL ratings of 3, 4, or 5 by the following March (in year+2). The final column notes the number of banks that initially had poor CAMEL ratings in March (in year t+1).

Summary statistics for this sample are described in Table 6. The *full sample* corresponds to 1985-2000 while the *recent sample* includes data on internal risk ratings which are available only starting in 1997.

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[8] This pattern persists for eight quarters before our measurement of non-performing loans, and so is not completely explained by seasoning effects. Because it takes a few quarters before a new loan becomes non-performing, an increase in loan growth should initially reduce non-performing loans regardless of how risky they might be.

Table 7 illustrates the results of our forecasting exercise. As in the analysis above, in the first three columns standard errors are clustered at the bank level and in the final three columns we employ bank fixed effects. The first column highlights the main result of interest: conditional on other variables that are used in the Federal Reserve System's SEER model, the portfolio interest rate on new C&I loans has highly significant marginal predictive power. Controlling for loan growth in column (2) or the non-price terms of lending in column (3) does no change or weaken this result. Interestingly, only the fraction of new loans that are secured appears to have any significant explanatory power. These results are simply strengthened when using bank fixed effects in the final three columns. When comparing loan portfolios across banks, a one percentage point increase in the average interest rate on new C&I loans increases the probability of a CAMEL downgrade by 88 basis points, which using the sample mean from Table 6 is quite large. On the other hand when comparing loan portfolios for a particular bank over time, a one percentage point increase in the average interest rate increases the probability of a downgrade by more than 1.3 percentage points in the last column, more than one-third of the sample mean. We interpret this as strong evidence that interest rates have significant marginal explanatory power both across banks and over time.

Finally note that as above when analyzing loan performance, the coefficient on C&I loan growth indicates that strong C&I loan growth is only good news about future bank performance.

Do Loan Interest Rates Perform Better than Internal Ratings of Risk?

Since 1997, the STBL has included banks' own, internal ratings of the new loans they make each quarter. English and Nelson (1998) discuss the internal loan ratings collected from banks in the STBL since 1997. Using terms on the 42,000 loans reported by banks in the August, 1998 STBL, they find the expected positive correlation between banks' loan ratings and the rates on those loans, even after controlling for the other terms of lending. On whether the ratings predict loan performance—the question we are most interested in here—their findings are "disappointing," (p. 21): charge-off rates are insignificantly related to the reported share of high-risk loans and *positively* related to the share of low-risk loans.

In this section we conduct two exercises. First, we compare how well internal ratings forecast future loan performance relative to interest rates. Second, we compare how well internal ratings forecast the probability of a CAMEL downgrade relative to average loan rates.

The results of our first exercise are displayed in Table 8, which simply adds to the model of loan performance above four lags of the average internal rating on new C&I loans. The first three columns employ clustering at the bank level and final three columns use bank fixed effects. The first two columns demonstrate that the relationship between loan interest rates and loan performance persists in the more recent sample, although the relationship is a bit weaker even before conditioning on internal ratings. The third column demonstrates internal ratings add no explanatory power to the model and have little effect on the explanatory power of the interest rate variables. The negative sign on most of the internal rating variables would suggest that banks that have a more risky loan portfolio tend to have better future loan performance. The results with fixed effects are statistically weaker but deliver the same message: internal ratings have very little predictive power for future loan performance and are consequently out-performed by loan interest rates.[9]

The results of our second horse race are displayed in Table 9, which simply adds to our model of CAMEL downgrades the average internal rating on new C&I loans. The first two columns demonstrate that the previous results continue to hold in the more recent data, which is remarkable given there are only 10 downgrades of STBL-reporting banks since 1997. The third column adds other non-price loan terms, and it is worth noting that only the fraction of new loans secured seems to matter with the opposite sign as in the previous table. The fourth column implies that the average internal risk rating adds no explanatory power over average portfolio interest rates. The final columns use bank fixed effects. We

[9] See English and Nelson (1998) on the risk ratings reported in the STBL. Treacy and Carey (2000) describe the ratings systems at the 50 largest U.S. bank holding companies.

note that the effect of loan interest rates on downgrades goes away, but do not worry much about this with only 10 downgrades.

Finally, we take a slight detour and look more closely at the relationship between average loan interest rates and internal risk ratings in Table 10. The first column is a simple regression of the portfolio interest rate on the average risk rating with a full set of time effects and is clustered at the bank level. The coefficient on risk indicates that there is very little relationship across banks between the internal risk rating and interest rate. This result is quite disappointing as in principle each bank is using a similar set of definitions for each risk category. The second column adds non-price loan terms as control variables, and this appears to strengthen the relationship between risk and return somewhat. The final two columns add bank fixed effects to each of the first two columns, implicitly focusing on the relationship between changes in internal ratings and portfolio interest rates, and are much more significant. Unsurprisingly, the exercise indicates that the relationship between risk and return is much stronger when focusing on changes in a banks ratings over time as opposed to focusing on differences in risk ratings across banks.

Conclusions.

As expected from theory, loan interest rates have significant explanatory power in predicting future loan performance and in forecasting downgrades in bank CAMEL ratings. These results indicate that bank supervisors might find it useful to monitor loan interest rates in the off-site surveillance of banks as portfolio interest rates have significant marginal explanatory power over and above the variables used in the Federal Reserve's SEER model.

At the same time, it is fairly significant to note that average internal risk ratings have little explanatory power in predicting future loan performance or in forecasting CAMEL downgrades. As is such, ratings are badly out-performed by loan portfolio interest rates in predicting future performance. This latter result should prompt more research into whether or not they are appropriate for setting risk-based capital requirements.

In the meantime, we propose that regulators consider the use of loan interest rates instead of internal ratings in setting capital charges or in pricing deposit insurance. In theory, interest-rate based regulation is compatible with bank's incentives and could plausibly fix some of the underlying problems that motivate the regulation of banks in the first place. The practical challenge for this approach is for regulators to identify the efficient frontier **R(x)** that constrains a bank's choice problem. In principle, this frontier might vary across banks and loan markets and over time, and it is unclear how difficult it might be to develop a meaningful mapping from loan interest rates to actual risk choice. At a minimum, we feel that the evidence developed here is interesting enough to prompt greater study into the usefulness of loan interest rates and internal risk ratings in regulating banks.

While there is no natural way for a bank to game interest-rate based regulation when the relationship between the lender and borrower is limited to a debt contract, we understand that will not necessarily be the case when a borrower interacts with its lender through several avenues. In particular, a bank might be able to reduce the burden of regulation by reducing the interest rate on a borrower's loan and increasing fees for other services. A recent example if this type of cross-subsidization would be large banks trying to attract securities underwriting business with below market rates on commercial loans. We don't view this as an important problem because interest-rate based regulation would generate a great deal of information about how bank loans are typically priced, so it wouldn't be hard for regulators to scrutinize lender-borrower relationships on loans that appear to be under-priced relative to the market. Another important point is that while the bank can credibly communicate the risk of the underlying relationship to its regulator when the instrument is a debt contract, this is no longer the case when the bank is also permitted to have an equity stake in the firm. With debt and equity stakes in a borrower, the bank actually enjoys the upside benefits of greater risk, unraveling the underlying mechanism that permitted interest rate based regulation to work in the framework above. It is thus important to recognize the incentives that banks would have to engineer other financial instruments beyond simple debt contracts in order to reduce the burden of regulation.

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Figure 1: Optimal Risk Choice

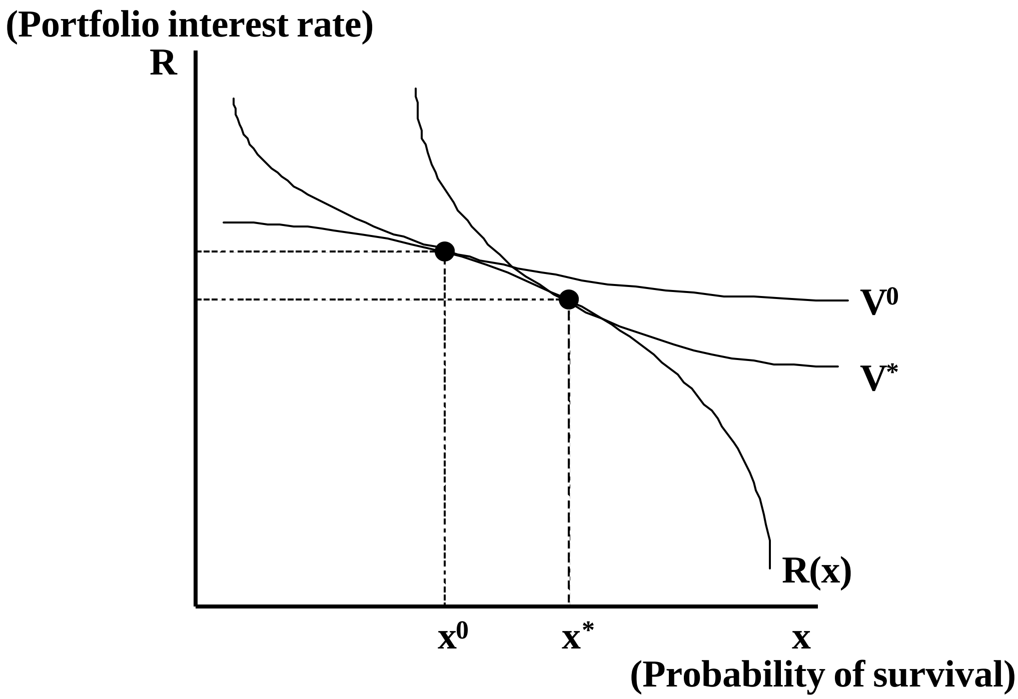

Figure 2: Shifts in the Efficient Frontier

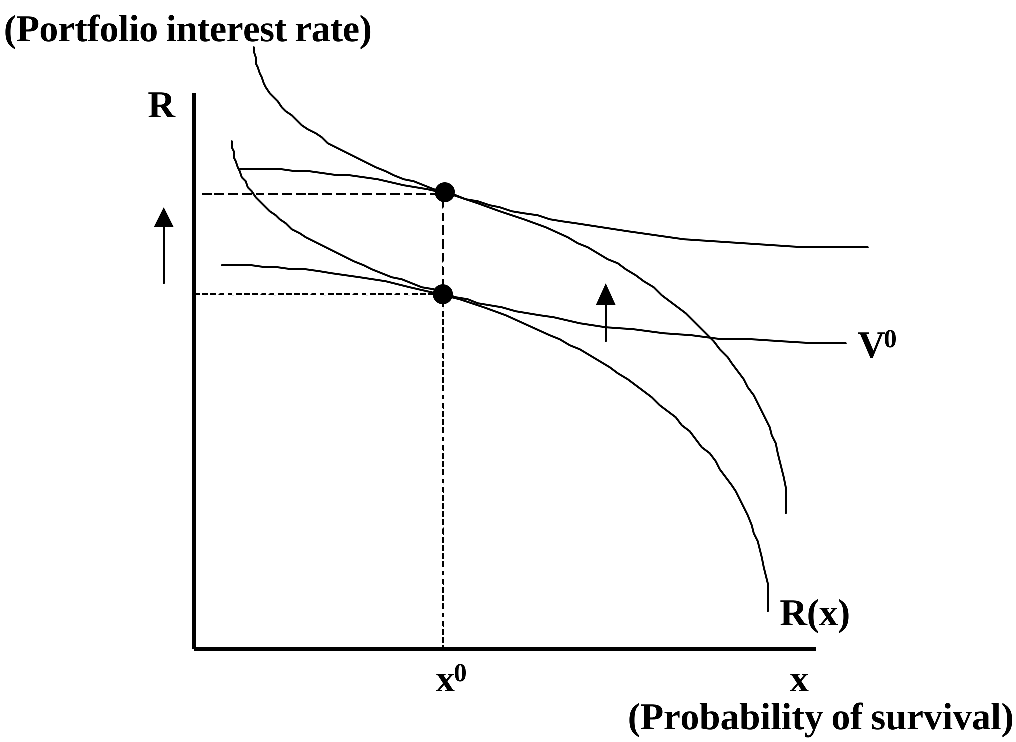

Figure 3: New C&I Loan Portfolio Interest Rates

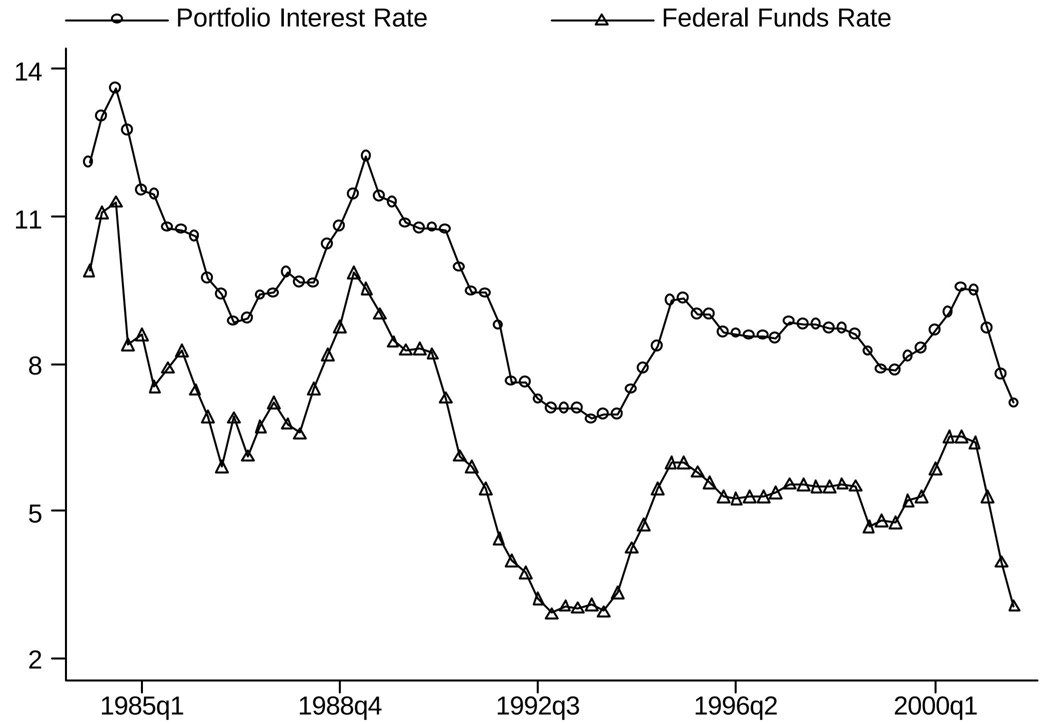

Figure 4: Cross-Sectional Densities of PortfolioInterest Rates

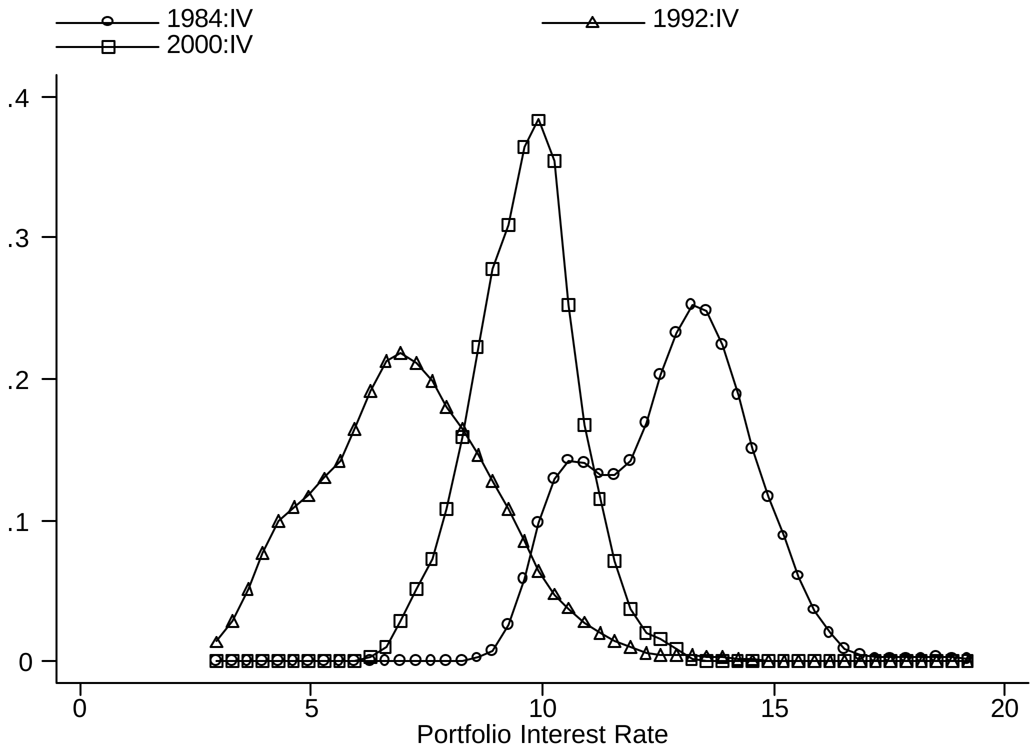

Figure 5: Non-Price Terms of New C&I Loans

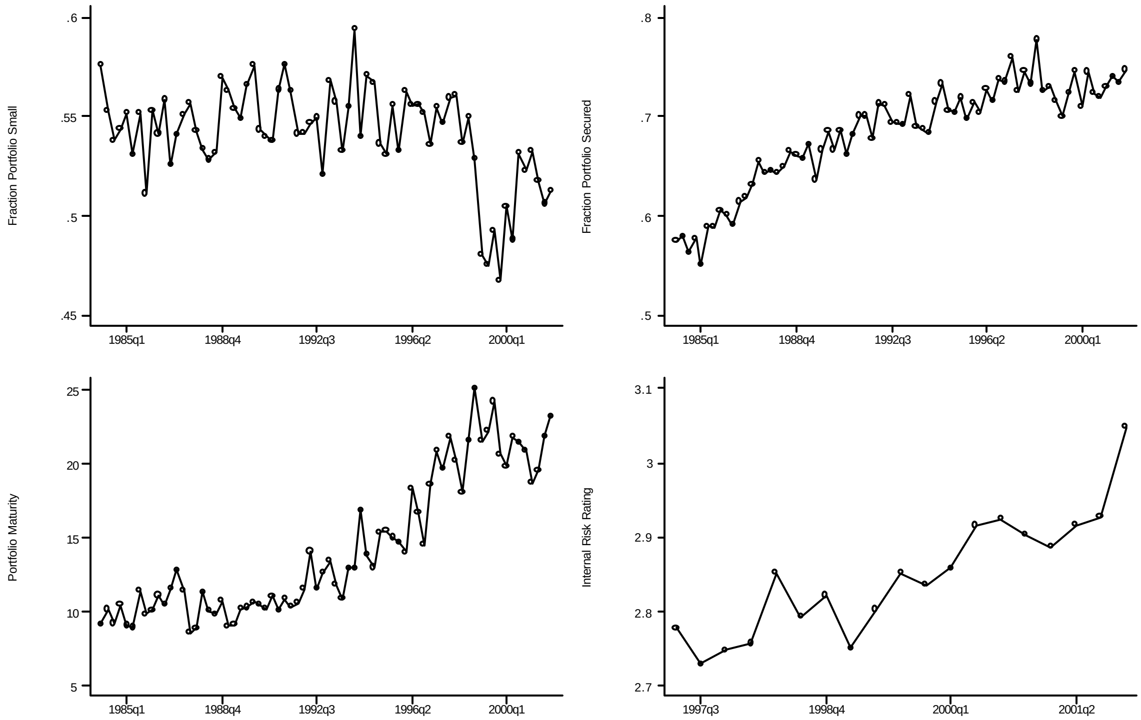

Table 1: Frequency Distribution of STBL-reporting Banks

	Quarter				
Year	1	2	3	4	Total
1984	317	316	311	310	1,254
1985	304	300	308	299	1,211
1986	297	292	306	310	1,205
1987	309	308	318	307	1,242
1988	310	311	303	303	1,227
1989	298	317	311	309	1,235
1990	305	310	312	310	1,237
1991	324	325	319	314	1,282
1992	316	314	315	311	1,256
1993	304	289	295	281	1,169
1994	282	286	285	280	1,133
1995	275	286	281	280	1,122
1996	288	275	260	257	1,080
1997	254	271	252	260	1,037
1998	255	252	251	252	1,010
1999	261	261	249	239	1,010
2000	222	227	224	217	890
2001	236	231	227	232	926
Total	5,157	5,171	5,127	5,071	20,526

Notes: the sample includes all banks that report making loans during the survey week in February, May, August, and November of the *Survey of Terms of Business Lending.*

Table 2: Lagged Loan Portfolio Interest Rates Predict Non-Performing C&I Loans

	(1)	(2)	(3)	(4)
i_{it-1}	0.0109*	0.0092*	0.0085*	0.0081*
	(0.0018)	(0.0018)	(0.0015)	(0.0016)
i_{it-2}	0.0072*	0.0079*	0.0054*	0.0055*
	(0.0017)	(0.0017)	(0.0014)	(0.0014)
i_{it-3}	0.0054*	0.0051*	0.0029*	0.0027*
	(0.0018)	(0.0018)	(0.0013)	(0.0013)
i_{it-4}	0.0057*	0.0052*	0.0031*	0.0034*
	(0.0019)	(0.0017)	(0.0014)	(0.0012)
$\Delta \ln(L^{cai})_{t-1}$		-0.0815*		-0.0595*
		(0.0158)		(0.0102)
$\Delta \ln(L^{cai})_{t-2}$		-0.0806*		-0.0582*
		(0.0163)		(0.0108)
$\Delta \ln(L^{cai})_{t-3}$		-0.0801*		-0.0599*
		(0.0157)		(0.0105)
$\Delta \ln(L^{cai})_{t-4}$		-0.0782*		-0.0553*
		(0.0188)		(0.0133)
Time Effects	Yes	Yes	Yes	Yes
Bank Effects	No	No	Yes	Yes
N	15,955	15,092	15,955	15,092
R-sq	0.144	0.175	0.578	0.629

Notes: the table reports coefficients and standard errors of a regression of non-performing C&I loans on four lags of the average interest rate on C&I loans in the first column and adds four lags of C&I loan growth in the second column. Standard errors have bee corrected for heteroskedasticity and clustered at the bank level. In the second two columns, we employ bank fixed effects in place of clustering.

Table 3: Lagged Loan Portfolio Interest Rates Predict Charge-Offs

	(1)	(2)	(3)	(4)
i_{it-1}	0.0010*	0.0010*	0.0007	0.0009
	(0.0004)	(0.0004)	(0.0005)	(0.0005)
i_{it-2}	0.0005	0.0005	0.0003	0.0000
	(0.0004)	(0.0004)	(0.0004)	(0.0005)
i_{it-3}	0.0000	0.0000	0.0000	-0.0001
	(0.0003)	(0.0003)	(0.0004)	(0.0004)
i_{it-4}	0.0008	0.0008	0.0009	0.0010
	(0.0005)	(0.0006)	(0.0008)	(0.0008)
$\Delta\ln(L^{cai})_{t-1}$		-0.0060*		-0.0032
		(0.0020)		(0.0019)
$\Delta\ln(L^{cai})_{t-2}$		-0.0071*		-0.0040*
		(0.0013)		(0.0017)
$\Delta\ln(L^{cai})_{t-3}$		-0.0097*		-0.0067*
		(0.0016)		(0.0020)
$\Delta\ln(L^{cai})_{t-4}$		-0.0071*		-0.0039*
		(0.0013)		(0.0017)
Time Effects	Yes	Yes	Yes	Yes
Bank Effects	No	No	Yes	Yes
N	15,288	14,462	15,288	14,462
R-sq	0.014	0.015	0.163	0.185

Notes: the table reports coefficients and standard errors of a regression of C&I loan charge-offs on four lags of the average interest rate on C&I loans in the first column and adds four lags of C&I loan growth in the second column. Standard errors have bee corrected for heteroskedasticity and clustered at the bank level. In the second two columns, we employ bank fixed effects in place of clustering.

Table 4: Lagged Loan Portfolio Interest Rates Do Not Predict Provisions

	(1)	(2)	(3)	(4)
i_{it-1}	-0.0007	-0.0008	-0.0035	-0.0023
	(0.0009)	(0.0010)	(0.0037)	(0.0027)
i_{it-2}	-0.0026	-0.0027	-0.0034	-0.0056
	(0.0028)	(0.0029)	(0.0040)	(0.0054)
i_{it-3}	0.0016	0.0017	0.0016	0.0013
	(0.0018)	(0.0019)	(0.0029)	(0.0034)
i_{it-4}	0.0072	0.0078	0.0096	0.0097
	(0.0072)	(0.0078)	(0.0085)	(0.0085)
$\Delta\ln(L^{cai})_{t-1}$		0.0094		0.0026
		(0.0117)		(0.0061)
$\Delta\ln(L^{cai})_{t-2}$		0.0021		0.0022
		(0.0041)		(0.0063)
$\Delta\ln(L^{cai})_{t-3}$		0.0061		0.0079
		(0.0080)		(0.0089)
$\Delta\ln(L^{cai})_{t-4}$		0.0014		0.0027
		(0.0040)		(0.0061)
Time Effects	Yes	Yes	Yes	Yes
Bank Effects	No	No	Yes	Yes
N	15,808	14,967	15,808	14,967
R-sq	0.005	0.005	0.148	0.171

Notes: the table reports coefficients and standard errors of a regression of total loan provisions on four lags of the average interest rate on C&I loans in the first column and adds four lags of C&I loan growth in the second column. Standard errors have bee corrected for heteroskedasticity and clustered at the bank level. In the second two columns, we employ bank fixed effects in place of clustering.

Table 5: Frequency of Bad CAMEL Ratings and CAMEL Downgrades Among STBL Reporting Banks

	CAMEL 1,2			CAMEL 3,4,5
Years	Non-Downgrades	Downgrades	Total	
1985-1987	435	12	447	139
1988-1990	559	92	651	251
1991-1993	689	2	691	212
1994-1996	798	3	801	16
1997-2000	929	10	939	29
Total	3,410	119	3,529	647

Notes: the sample includes STBL-reporting banks that had CAMEL ratings of 1 or 2 as of March of the following year. Downgrades refer to banks that have their CAMEL ratings downgraded to 3, 4, or 5 between March of the following year and March two years into the future.

Table 6: Summary Statistics for the CAMEL Downgrade Samples

	Full Sample	*Recent Sample*
Loan Interest Rate (i_t)	8.977	8.691
	(1.930)	(1.276)
$\Delta\ln(L^{cai})$	0.029	0.038
	(0.138)	(0.145)
Pr(DOWNGRADE)	0.036	0.010
	(0.187)	(0.101)
Ln(Assets)	13.721	14.180
	(2.239)	(2.425)
C&I Lending/Loans	0.151	0.161
	(0.095)	(0.107)
Real Estate Lending/Loans	0.251	0.314
	(0.124)	(0.135)
OREO/Assets	0.002	0.001
	(0.004)	(0.002)
ROA	0.011	0.012
	(0.005)	(0.005)
Securities/Assets	0.253	0.233
	(0.134)	(0.126)
Equity/Assets	0.081	0.090
	(0.025)	(0.030)
Large Deposits/Assets	0.150	0.270
	(0.138)	(0.113)
Risk		2.810
		(0.717)
N	3,410	779

Notes: The table reports sample means and standard deviations of selected variables from the December Call Reports 1985-2000. The sample includes STBL-reporting banks that had CAMEL ratings of 1 or 2 as of March 1986-2001.

Table 7: Loan Portfolio Interest Rates Predict CAMEL Downgrades

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Assets)	0.0017	0.0021	0.0008	0.0061	0.0106	0.0106
	(0.0020)	(0.0021)	(0.0021)	(0.0129)	(0.0134)	(0.0134)
C&I	0.2415*	0.2354*	0.2304*	0.2637*	0.2245*	0.2219*
Loans	(0.0468)	(0.0476)	(0.0478)	(0.1064)	(0.1083)	(0.1083)
Real Estate	0.1061*	0.1109*	0.1181*	0.2369*	0.2478*	0.2513*
Loans	(0.0302)	(0.0310)	(0.0322)	(0.0756)	(0.0808)	(0.0810)
OREO	-0.9121	-0.4131	-0.4102	0.2269	0.7789	0.7504
	(1.0983)	(1.2274)	(1.2390)	(1.8067)	(1.9833)	(2.0071)
ROA	-2.1755*	-1.7854*	-1.7663*	-2.1831*	-1.6594	-1.6463
	(0.7085)	(0.6440)	(0.6447)	(0.9192)	(0.8830)	(0.8854)
Securities	-0.0199	-0.0171	-0.0158	-0.1193*	-0.1217	-0.1220
	(0.0235)	(0.0239)	(0.0242)	(0.0605)	(0.0639)	(0.0641)
Equity	-0.2681*	-0.2497*	-0.2533*	-0.5135*	-0.5242*	-0.5218*
	(0.0941)	(0.0950)	(0.0967)	(0.2034)	(0.2139)	(0.2166)
Large CDs	-0.0569*	-0.0471*	-0.0415*	-0.1339*	-0.1333*	-0.1312
	(0.0196)	(0.0196)	(0.0202)	(0.0649)	(0.0677)	(0.0676)
Bad C&I	-0.0168	-0.0287	-0.0279	-0.0439	-0.0712	-0.0708
Loans	(0.0184)	(0.0212)	(0.0209)	(0.0330)	(0.0392)	(0.0386)
Bad Total	1.0080*	0.9070*	0.9030*	1.1502*	1.0212*	1.0324*
Loans	(0.2238)	(0.230)	(0.2289)	(0.3396)	(0.3651)	(0.3659)
i_{it}	0.0088*	0.0084*	0.0113*	0.0113*	0.0116*	0.0133*
	(0.0026)	(0.0028)	(0.0034)	(0.0034)	(0.0038)	(0.0041)
$\Delta\ln(L^{cai})$		-0.0290	-0.0282		-0.0470*	-0.0478*
		(0.0176)	(0.0176)		(0.0182)	(0.0183)
Fraction			-0.0091			-0.0062
Small			(0.0121)			(0.0153)
Fraction			-0.0256*			-0.0215
Secured			(0.0109)			(0.0134)
Maturity			0.0000			0.0001
			(0.0001)			(0.0001)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Effects	No	No	No	Yes	Yes	Yes
N	3,529	3,315	3,315	3,529	3,315	3,315
R-sq	0.128	0.131	0.132	0.311	0.315	0.316

Notes: the table reports coefficients and standard errors from an OLS regression of CAMEL downgrade over the next year on bank-level characteristics from the previous December. The second column adds the average interest rate on loans made in the previous November while the third column adds C&I loan growth in the fourth quarter. A full set of time effects is used in every specification. The final three columns use bank fixed effects. Standard errors have bee corrected for heteroskedasticity and are clustered at the bank level in specifications that do not employ bank fixed effects.

Table 8: Loan Portfolio Interest Rates Predict Non-Performing C&I Loans Better than Internal Risk Ratings

	(1)	(2)	(3)	(4)	(5)	(6)
i_{it-1}	0.0013	0.0009	-0.0003	0.0013*	0.0003	0.0014
	(0.0018)	(0.0024)	(0.0024)	(0.0013)	(0.0016)	(0.0015)
i_{it-2}	0.0019	0.0003	0.0014	0.0012*	0.0003	0.0006
	(0.0018)	(0.0026)	(0.0025)	(0.0011)	(0.0014)	(0.0014)
i_{it-3}	0.0047*	0.0055*	0.0052*	0.0023*	0.0030*	0.0037*
	(0.0023)	(0.0032)	(0.0034)	(0.0011)	(0.0012)	(0.0013)
i_{it-4}	0.0033*	0.0038*	0.0039*	0.0013*	0.0017	0.0024
	(0.0013)	(0.0016)	(0.0017)	(0.0011)	(0.0013)	(0.0013)
$Risk_{it-1}$		-0.0026	-0.0006		0.0012	0.0014
		(0.0025)	(0.0023)		(0.0019)	(0.0018)
$Risk_{it-2}$		0.0000	-0.0011		0.0015	0.0014
		(0.0026)	(0.0026)		(0.0018)	(0.0019)
$Risk_{it-3}$		-0.0051	-0.0032		-0.0016	-0.0011
		(0.0034)	(0.0035)		(0.0017)	(0.0017)
$Risk_{it-4}$		-0.0015	-0.0028		0.0010	0.0003
		(0.0024)	(0.0024)		(0.0018)	(0.0018)
$\Delta\ln(L^{cai})_{t-1}$			-0.0149*			-0.0073
			(0.0067)			(0.0046)
$\Delta\ln(L^{cai})_{t-2}$			-0.0113			0.0023
			(0.0075)			(0.0049)
$\Delta\ln(L^{cai})_{t-3}$			-0.0140			-0.0042
			(0.0078)			(0.0051)
$\Delta\ln(L^{cai})_{t-4}$			-0.0125			-0.0040
			(0.0075)			(0.0049)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank Effects	No	No	No	Yes	Yes	Yes
N	3,146	2,412	2,288	3,146	2,412	2,288
R-sq	0.081	0.097	0.100	0.590	0.647	0.638

Notes: the table reports coefficients and standard errors of a regression of non-performing C&I loans on four lags of the average interest rate on C&I loans in the first column. In the second column, we add four lags of the average internal risk rating on new loans and in the third column adds four lags of C&I loan growth. Standard errors have bee corrected for heteroskedasticity and clustered at the bank level. In the second two columns, we employ bank fixed effects in place of clustering.

Table 9: Lagged Loan Portfolio Interest Rates Predict CAMEL Downgrades Better than Lagged Internal Risk Ratings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Assets)	-0.0012	0.0001	0.0006	0.0006	0.0415	0.0339	0.0331	0.0331
	(0.0024)	(0.0020)	(0.0026)	(0.0026)	(0.0394)	(0.0386)	(0.0389)	(0.0389)
C&I	0.0328*	0.0040*	0.0057*	0.0057*	-0.2349*	-0.3481*	-0.3544*	-0.3544
Loans	(0.0770)	(0.0726)	(0.0720)	(0.0720)	(0.2271)	(0.2356)	(0.2378)	(0.2378)
Real Estate	-0.0560*	-0.0603*	-0.0640*	-0.0640*	-0.1469*	-0.1442*	-0.1420*	-0.1420
Loans	(0.0505)	(0.050)	(0.0534)	(0.0534)	(0.1227)	(0.1113)	(0.1126)	(0.1126)
OREO	-0.6381	0.7819	0.8275	0.8275	-1.2973	2.0922	2.5725	2.5725
	(1.4462)	(1.1170)	(1.0750)	(1.0750)	(5.4492)	(4.8379)	(5.5109)	(5.5109)
ROA	-0.5791*	-0.7354*	-0.7642*	-0.7642*	1.6951*	1.6317	1.6721	1.6721
	(0.7968)	(0.8399)	(0.8405)	(0.8405)	(2.0137)	(2.1820)	(2.2206)	(2.2206)
Securities	-0.0733	-0.0567	-0.0575	-0.0575	-0.1049*	-0.1622	-0.1585	-0.1585
	(0.0508)	(0.0487)	(0.0486)	(0.0486)	(0.1471)	(0.1541)	(0.1562)	(0.1562)
Equity	-0.2371*	-0.1682*	-0.1668*	-0.1668*	-0.6713*	-0.8090*	-0.8185*	-0.8185*
	(0.1082)	(0.0949)	(0.0957)	(0.0957)	(0.4223)	(0.4853)	(0.4931)	(0.4931)
Large CDs	-0.0034*	0.0161*	0.0170*	0.0170	0.0128*	-0.0250*	-0.0283	-0.0283*
	(0.0373)	(0.0370)	(0.0385)	(0.0385)	(0.0779)	(0.0599)	(0.0630)	(0.0630)
Bad C&I	0.0392	0.0346	0.0397	0.0397	0.0675	-0.0054	0.0024	0.0024
Loans	(0.0589)	(0.0540)	(0.0541)	(0.0541)	(0.0998)	(0.0872)	(0.0834)	(0.0834)
Bad Total	0.5499*	0.3866*	0.3744*	0.3744*	0.1690*	-0.2590*	-0.2711*	-0.2711
Loans	(0.3414)	(0.3330)	(0.3359)	(0.3359)	(0.4252)	(0.3052)	(0.3407)	(0.3407)
i_{it}	0.0105*	0.0077*	0.0063*	0.0063*	-0.0002	-0.0029	-0.0038	-0.0038
	(0.0053)	(0.0044)	(0.0043)	(0.0043)	(0.0057)	(0.0048)	(0.0062)	(0.0062)
$\Delta \ln(L^{cai})$		-0.0137	-0.0135	-0.0135		-0.0025	-0.0043	-0.0043
		(0.0141)	(0.0143)	(0.0143)		(0.0128)	(0.0133)	(0.0133)
Fraction			0.0070	0.0070			-0.0042	-0.0042
Small			(0.0083)	(0.0083)			(0.0074)	(0.0074)
Fraction			0.0047	0.0047			-0.0002	-0.0002
Secured			(0.0158)	(0.0158)			(0.0207)	(0.0207)
Maturity			0.0000	0.0000			0.0000	0.0000
			(0.0001)	(0.0001)			(0.0001)	(0.0001)
Risk Rating				0.0010				0.0059
				(0.0033)				(0.0061)
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Effects	No	No	No	No	Yes	Yes	Yes	Yes
N	779	728	728	728	779	728	728	728
R-sq	0.034	0.028	0.028	0.028	0.493	0.520	0.521	0.521

Notes: the table reports coefficients and standard errors from an OLS regression of CAMEL downgrade over the next year on bank-level characteristics from the previous December. The second column adds C&I loan growth in the fourth quarter while the third column adds the average of other non-price C&I loan terms. The fourth column adds the average internal risk rating. A full set of time effects is used in every specification. The final four columns use bank fixed effects. Standard errors have bee corrected for heteroskedasticity and are clustered at the bank level in specifications that do not employ bank fixed effects.

Table 10: Loan Portfolio Interest Rates are Weakly Correlated with Internal Risk Ratings

	(1)	(2)	(1)	(2)
Risk	0.033	0.189*	0.414*	0.381*
	(0.033)	(0.028)	(0.033)	(0.033)
Secured		0.907*		0.246*
		(0.066)		(0.071)
Maturity		0.003*		-0.001
		(0.001)		(0.001)
Small		2.139*		0.878*
		(0.046)		(0.057)
Fixed Effects	No	No	Yes	Yes
N	4,356	4,356	4,356	4,356
R-sq	0.241	0.656	0.845	0.859

Notes: the table reports coefficients and standard errors from a regression of the average loan interest rate on average loan risk rating, loan maturity, and fraction of loans or commitments with a face value of less than $250,000. Each regression includes a full set of time effects, and the second two columns include bank fixed effects. The sample includes quarterly data 1997:I-2001:IV. Standard errors have been corrected for heteroskedasticity. Coefficients statistically different from zero at the 10 percent level are in bold.