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Capital Regulation and Bank Lending

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Bank regulation in general and capital regulation in particular are widely perceived as having become stiffer in the 1990s. The stiffer regulatory environment in turn is argued to have curtailed bank lending. This article determines the extent to which capital standards changed in the 1990s and examines the relationship between capital positions and the bank lending. The empirical results suggest that capital standards did increase in the 1990s. The analysis also shows that bank loan growth rates are positively related to capital-to-assets ratios. Moreover, sensitivity of bank lending to capital positions appears to have increased in the 1990s. Regionally, capital regulation likely had the most pronounced effect on bank lending in New England.

The phasing in of international, risk-based capital standards and the growing concern over the risk-exposure of the deposit insurance system are viewed as precipitating stiffer bank capital regulation in recent years. This stiffening of capital regulation is argued to have restricted bank lending beginning in 1990, and, thereby, contributed to a credit crunch.

Consistent with this view, Federal Reserve surveys on bank lending practices find that many banks tightened credit standards in 1990 and 1991 in part due to the volume of problem loans and capital constraints. In addition, some recent studies find a positive relationship between levels of bank capital and bank loan growth in 1990 (Furlong 1991, Bernanke and Lown 1991, and Peek and Rosegren 1991).[1]

The evidence, however, does not indicate the extent to which the relationship between bank capital and bank lending in recent years marks a change from the past. Capital standards traditionally have been a component of bank regulatory policy, and enforcement of such standards could be expected to have influenced lending by individual banks even prior to 1990. The purpose of this study is to examine the extent to which bank capital regulation has changed in the 1990s and the effect the change has had on the relationship between bank capital and lending. The analysis in this paper differs from past studies by using cross-section time series data for individual banks from across the United States rather than cross-section data for a single time period.

The first section of this study discusses the link between capital regulation and bank lending in terms of the regulatory objective of creating microeconomic incentives for banks that are consistent with limiting the risk exposure of the deposit insurance system. The second section compares effective capital standards among banks by size and chartering authority and examines how bank capital standards have changed. The empirical analysis in the third section looks at how the relationship between the financial conditions of banks and their lending has changed over time and whether the effects on bank lending vary by bank size and by geographic region.

[1]Baer and McElravey (1992) find a positive relationship between banks' capital positions and growth rates in assets.

I. THE LINK

In the U.S. banking system, the roles of the federal deposit insurance system and the bank regulatory agencies parallel those of liability holders in private contracts. The deposit insurance system bears financial liability, and the regulatory agencies have monitoring responsibilities analogous to those of private liability holders.

A major criticism of the current institutional arrangement is that, while the roles may be parallel, the deposit insurance system and the regulatory agencies do not necessarily have the same incentive as private liability holders.[2] Nevertheless, regulatory measures are observed that at least in form resemble those seen in private debt agreements that are intended to control risk-taking.

The most obvious example is capital regulation, which is analogous to private debt covenants constraining leverage. Jensen and Meckling (1976) point out that equity holders in general have an incentive to increase risk once debt has been issued. One method for a firm to increase risk is to increase its leverage. To control that incentive, private debt contracts often include provisions limiting the ability of a firm to dilute its capital position.

The importance of capital regulation in banking *per se* is highlighted by Merton (1977) and the large number of studies spawned by that study, which show that the deposit insurance guarantee is essentially a put option, with the value varying negatively with a bank's capital-to-asset position. The options model of deposit insurance thus implies that, with subsidized deposit insurance, a value-maximizing bank has an incentive to increase leverage indefinitely, thus making it necessary for leverage to be constrained by the enforcement of bank capital requirements.

The enforcement of capital requirements can link a bank's capital position with its lending simply as part of the process of a bank meeting regulatory standards. For example, if bank equity is not perfectly elastic, a bank with too little capital could attempt to improve its capital position by reducing its size, and one way to do that is to decrease loans. Indeed, Keeley (1988) finds that in the 1980s, banks deficient in capital did adjust their capital positions in part by growing more slowly than other banks. More generally, banks with stronger capital positions have more capacity to expand loans and still meet regulatory capital standards.

The recent adoption of risk-based capital standards for banks could reinforce the link between a bank's financial condition and its investment decisions. For example, when determining the level of risk-adjusted assets, a zero weight is given to assets with no default risk, such as Treasury securities, while riskier assets, such as loans, are given higher weights.[3] As a result, for a given level of capital, a bank can increase its risk-based capital-to-asset ratio simply by reducing the volume of loans held in its portfolio and acquiring Treasury securities. Such an adjustment would tend to reduce the growth rate of loans.[4]

The options model of the deposit guarantee also suggests another regulatory rationale for linking leverage and the growth of risky assets such as loans. Merton shows that the value of the deposit insurance guarantee is positively related to the degree of asset or nonleverage risk of a bank. This implies that regulatory policy that takes into account the liability of the insurance system can be expected to extend effort to control nonleverage risk.

Moreover, Furlong and Keeley (1989) show that the positive effect of a rise in nonleverage risk on the value of the insurance guarantee increases with a bank's leverage. That is, with higher leverage and mispriced deposit insurance, a bank would have more incentive to expand nonleverage risk. This suggests that regulatory policy should be most concerned with the expansion of nonleverage risk by institutions with the least amount of capital.

Two ways a bank can increase nonleverage risk are to grow and acquire loans (or other assets) that add to its overall risk or to adjust the composition of its existing portfolio toward riskier assets such as loans. From a regulatory perspective, a link between loan growth and leverage could be rationalized as one way of limiting a bank's ability to exploit the insurance system through either of these two options. Loan growth would be more restricted at banks with less capital since they would have the greatest incentive to increase nonleverage risk.[5]

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[2]To the extent that the incentive structure differs, regulatory policy and bank behavior will not necessarily coincide with what would be predicted from models of unregulated, uninsured banks. Indeed, Kane (1989) argues that much of the blame for the thrift crisis in the 1980s and the demise of the Federal Savings and Loan Insurance Corporation falls on the nonmarket incentives structure faced by regulators as well as on the incentives inherent in the deposit insurance system for institutions to take risk.

[3]Risk-based capital standards assign risk weights to all bank assets. The weights are determined by considering the credit (default) risk of assets. For example, the lowest risk category includes cash and U.S. Treasury securities, and has a zero weight, which means holdings of these securities do not add to a bank's risk-adjusted assets. The highest risk category includes most loans to private entities (but not home mortgage loans) and has a weight of 100 percent. The standards also account for credit risk of *off-balance* sheet activities such as interest rate swaps and stand-by letters of credit.

[4]Under the risk-based standards, banks also are subject to a leverage ratio requirement, which is a ratio of capital to balance sheet assets including Treasury Securities. Thus, a bank would not be able to increase leverage indefinitely by shifting to assets with a zero weight.

[5]Bernanke and Gertler (1987) show that the financial condition of uninsured, unregulated banks also could be expected to affect their lending. In their model, banks invest in loans (risky assets) because they

II. Changing Capital Standards in the 1990s

Capital regulation has always played some role in bank regulatory policy. Over the past several years, however, the theoretical arguments connecting capital and bank risk and the more concrete evidence of the problems in the thrift and banking industries, which ultimately led to the demise of the FSLIC and the "recapitalization" of the bank insurance fund, heightened the awareness of the importance of equity in banking.

This awareness was reflected in the adoption of explicit minimum regulatory capital ratios for all but the largest banks in 1981 and the subsequent raising and extending of the minimum ratio to all banks in 1985. In an evaluation of the effects of the changes in capital standards during the first half of the 1980s, Keeley (1988) finds that they were effective in raising capital-to-asset ratios for publicly traded banks with low capital ratios.

Since 1985, additional important steps have been taken to place capital regulation at the center of regulatory policy. One in particular was the adoption of risk-based capital standards by the bank regulatory agencies.[6] The phase-in of these standards started in 1990 and it will be completed at the end of 1992. When fully phased in, the risk-based standards will require banks to maintain a minimum 4 percent ratio of Tier 1 capital to risk-adjusted assets, and an 8 percent ratio for Tier 1 plus Tier 2 capital. To be considered well capitalized, however, a bank would have to exceed the minimum ratios.[7] Tier 1 capital consists primarily of common equity, while Tier 2 capital can include subordinated debt and such instruments as cumulative perpetual preferred stock.

Since the current capital standards use a risk-adjusted measure of assets, the capital requirements under the current standards are not directly comparable to ratios associated with the standards applied in the 1980s. However, it is still possible to evaluate whether the new standards have led to more stringent regulatory regimes in terms of leading banks to hold more capital relative to what they held in the past.[8] To do so, this study examines the impact of regulatory policy on banks' ratios of equity-capital to total assets. This study assumes that banks have target equity-capital-to-asset ratios and that they adjust to those targets gradually over time. The adjustment process for bank i can be written as:

$$k_{i,t} - k_{i,t-1} = a\left(k^*_{i,t} - k_{i,t-1}\right),$$

where, k is the actual capital-to-asset ratio, k^* is the target ratio, and a is the rate of adjustment.

In the model, it is assumed that capital regulation is binding and that k^* reflects the level of capital the regulator views as appropriate given the nonleverage risk of the bank.[9] The target ratio, however, is not necessarily a minimum ratio or a required regulatory ratio. For example, if there are regulatory costs imposed on a bank that has a ratio below the level deemed appropriate by the regulator, the bank may choose to hold additional capital as a buffer against shocks to equity. The target ratio for the bank also would reflect such a buffer. Finally, the partial adjustment process implies that adjusting capital is costly.

With data on the actual capital ratios, the expression above was used to estimate average target ratios and rates of adjustment for various groupings of banks. Average target ratios and adjustment parameters were estimated for all banks, for large and small banks separately, and for national and state chartered banks. If capital regulation became stiffer in 1990, the average target ratios or rates of adjustment would be expected to have increased.

The data used for estimation are from year-end Call Reports for commercial banks over the period 1985 through

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have more information on loans than do liability holders and the information cannot be transferred. Given the information asymmetry on risky investments, the capital of a bank is necessary to assure liability holders that the bank would be able to make good on the promised return to depositors. Assuming a bank's capital equity is not perfectly elastic, a negative shock to a bank's capital could impair its ability to meet its obligation to liability holders unless the bank also shifts its investment portfolio toward riskless assets and away from risky assets. This says that the adequacy of a bank's capital would affect the makeup of its portfolio.

[6]The prominence of capital regulations was heightened further by the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991, which directs the regulatory agencies to use the risk-based capital standards to trigger specific regulatory responses in a protocol called "prompt corrective action." Under the protocol, as a bank's capital falls, the bank faces more restrictions and the regulatory agencies have less flexibility in dealing with the bank.

[7]Using the current risk-based capital standards, the FDICIA established five categories that are intended to reflect banks' capital adequacy. The five categories are: (1) *well-capitalized,* which includes institutions that significantly exceed the capital requirements; (2) *adequately capitalized,* which includes banks meeting all requirements; (3) *undercapitalized,* which includes banks not meeting at least one capital requirement; (4) *significantly undercapitalized,* which includes banks well below at least one capital requirement; and (5) *critically undercapitalized,* which includes banks falling below a predetermined critical capital level.

[8]A general shift in bank portfolios could complicate comparisons over time. In recent years, the most obvious shifts in banking have been to Treasury securities and home mortgages. Under the risk-based standards, these assets have weights of less than 100 percent and an increase in their relative importance in bank portfolios could mask a shift to move stringent capital regulation.

[9]In recent years, it is possible that some banks have been impelled to improve capital positions by market pressures rather than by regulatory requirements.

1991. The data are for banks with assets of $100 million or more. Banks that acquired other banks in particular years are excluded from the sample for those years.[10]

The results from estimating the capital ratio adjustment equation for the various groupings of banks are reported in Table 1. The estimation procedure corrects for heteroskedasticity along the lines of White (1980). The figures in the first column represent estimates of the average target ratios and rates of adjustment for all banks in the sample.[11] The results show that for the period 1985–1989 the target capital-to-asset ratio was about 7.2 percent. For the 1990–1991 period, the ratio increased to about 8.8 percent. The increase in the ratio is statistically significant, and is consistent with a shift to a more stringent regulatory regime after 1989.

The estimate of the average adjustment factor also increases for the 1990–1991 period. However, the decrease is not statistically significant. Thus, while effective capital standards appear to have increased, the rate of adjustment in capital ratios for banks as a group is not indicative of more vigorous enforcement of the new standards.

The table also reports statistics by bank size and charter. Under bank asset size, the target ratios are higher for smaller banks than for larger banks. This is consistent with the view that smaller banks are required to hold more capital to offset their tendency to be less diversified and, thus, have higher nonleverage risk than larger banks.[12] On the other hand, the adjustment parameters are higher for the large banks. This would be the case if regulators enforced capital regulations more stringently for the larger banks. It also could be the case if capital requirements were binding more frequently for large banks than for small banks.

In terms of *changes* in regulatory policy, the target ratios increased for both large and small banks after 1989. The increase is statistically significant for small banks, which is consistent with an escalation in the stringency of capital regulation for those banks. The adjustment parameter for the sample of small banks declined slightly, though the

[10]The sample also excludes banks like credit card banks that do not engage in a broad array of banking activities. The sample also excludes banks with negative capital-to-asset ratios or ratios greater than one half.

[11]Nonlinear adjustment equations also were estimated. The results regarding changes in capital regulation are essentially the same as those shown in table 1. The estimated target ratios, however, are about a percentage point lower across the board.

[12]For example, results in Laderman, Schmidt, and Zimmerman (1991) suggest that small banks tend to lend in local markets and to have less diversified portfolios.

Table 1

Target Capital-to-Asset Ratios and Adjustment Parameters

		By Asset Size			By Charter		
Target Ratio	**All banks**	**$100 million to $1 billion**	**$1 billion or more**	**Difference**	**State**	**National**	**Difference**
1990–1991	0.0880**	0.0923**	0.0740**	0.0183†	0.0961**	.0822**	0.0139
1985–1989	0.0718**	0.0733**	0.0610**	0.0123**	0.0749**	.0664**	0.0085**
Difference	0.0162**	0.0191**	0.0130†		0.0212*	.0158**	
Adjustment Parameter							
1990–1991	0.0738**	0.0561**	0.1474†	−0.0913	0.0445	0.1154**	−0.0709
1985–1989	0.0762**	0.0740**	0.1268*	−0.0529	0.0964**	.0466**	0.0498
Difference	−0.0024	−0.0179	0.0206		−0.0519	.0688‡	

* significant at 5 percent level
** significant at 1 percent level
† significant at 10 percent level
‡ significant at 6 percent level

change is not significant. The target ratio and the adjustment parameter both increased for large banks after 1989, but only the change in the target ratio is statistically significant. The evidence, is then supportive of the hypothesis that capital regulation systematically became more stringent for the large banks.

Looking at banks by type of charter, the increases in the target ratios after 1989 are positive and significant for state-chartered and nationally chartered banks. Based on the changes in the target ratios, the shift in capital regulation was about the same for state-chartered banks as it was for nationally chartered banks, with the difference not statistically significant. The changes in the adjustment parameters, however, are consistent with more of a tightening of regulatory policy for the national banks. The adjustment parameter for the sample of national banks increased, with the change significant at the 6 percent level. For the state-chartered banks, the estimated adjustment parameter declined, but the change was not significant. In evaluating the overall stringency of regulatory policy it can be noted that the level of the target ratio tends to be higher for state-chartered banks.[13]

III. Capital Regulation and Bank Lending

Overall, the results in Table 1 indicate that capital regulation has been more stringent in recent years, which is consistent with regulatory policy that is increasingly concerned with the soundness of the deposit insurance system. The earlier discussion also suggests that such regulatory concerns could be expected to lead to a positive relation between the capital position of a bank and its rate of loan growth. The analysis in this section focuses on this relationship. In particular, it examines whether a bank's capital position affects its lending and whether that relationship has been affected by the shift in regulatory regime suggested by the results in the previous section.

The model used is a reduced form equation for the growth in bank loans:

$$\log(L_{i,t}/L_{i,t-1}) = f[g(k_{i,t-1}/k^*_{i,t}), X_{i,t}, e_{i,t}].$$

This expression says that the growth rate of loans at a given bank depends on the level of the actual capital ratio relative to the target ratio, a set of variables X, which represents other supply and demand factors, and an error term. If capital regulation affects bank lending, loan growth would be expected to be positively related to the spread between the actual and the target capital ratios. If the change in regulatory regime over the past few years has contributed to slower bank loan growth, the positive effect of the spread in the capital ratios on bank loan growth would be expected to have increased.

The other supply and demand variables included in the empirical analysis are the growth rate in personal income for the state in which the bank operates, a bank's ratio of current loans to total loans, and a bank's ratio of total loans to assets. The income variable is intended to control for general economic conditions faced by a bank and is expected to have a positive relation with loan growth. The ratio of current loans also could be an indicator of the economic environment in which a bank operates.[14] A higher ratio could be indicative of a stronger economic environment and could be associated with higher loan growth. This variable also could capture regulatory effects on a bank. Holding capital constant, banks with higher ratios of current loans should be viewed as being stronger financially. If so, the current loan ratio would be expected to have a positive relationship with loan growth. The other variable, the ratio of total loans to assets, is meant to control for the capacity of a bank to boost loan growth by shifting out of other assets in its portfolio. In this regard, the ratio would be expected to have a negative relationship with loan growth. Again, the effect of the loan-to-asset ratio on loan growth may reflect regulatory influences. All else equal, bank regulators could view banks with higher loan-to-asset ratios as being less financially sound and, therefore, may tend to limit the loan growth of such banks.

The basic equation used in estimation is:

$$\begin{aligned}\ln(L_{i,t}/L_{i,t-1}) = {} & c + B_1\ln(INC_{i,t}/INC_{i,t-1}) \\ & + B_2\ln(P/L)_{i,t-1} \\ & + B_3\ln(L/A)_{i,t-1} \\ & + B_4\ln(k_{i,t-1}/k^*_{i,t}) + e_{i,t},\end{aligned}$$

where:

L is total loans
INC is the level of the income in the state in which a bank operates
P is current loans
A is total assets
k is the actual equity capital-to-asset ratio, and
k^* is the target equity capital-to-asset ratio.

The target ratios are derived from the capital adjustment equation discussed earlier.[15] The targets differ by size

[13]This result holds up even when controlling for bank size.

[14]These are loans that are less than 30 days past due and accruing interest.

[15]The estimates of k^* from a nonlinear adjustment equation also were used in the loan growth equation. The statistical results are essentially the same as those in Tables 2 through 4.

of bank and by time period. Average targets were estimated separately for small banks ($100 million to $1 billion in assets) and large banks ($1 billion or more in assets) for the 1985–1989 period and the 1990–1991 period. Lagged values were used for P/L and L/A to avoid possible simultaneity problems. Once again, the interval used is one year, and the estimation procedure corrects for heteroskedasticity.

The loan growth equation was estimated over the period 1985 through 1991. The first column of Table 2 shows that the coefficients on state income growth and the quality of a bank's portfolio are positive and highly significant. The loan-to-asset ratio has a negative effect but is not statistically significant.

More central to the focus of this paper, the capital position variable, measured by the ratio of a bank's actual leverage to its target leverage, has a positive and statistically significant effect on bank loan growth. This is consistent with capital regulation having an effect on bank lending. The results for loan quality and the loan-to-asset ratio also may reflect regulatory influences on bank lending. Overall, these results support the view that regulatory policy does limit the loan growth of banks in weaker financial condition.

The last two columns in the table provide evidence on the shift in the behavior of bank lending in recent years and its possible relationship to bank capital regulation. In the second column, the shift in bank loan growth is measured by the coefficient on the bivariate dummy variable $D90\text{-}91$, which takes a value of 1 in 1990 and 1991 and a value of 0 in the earlier years. The coefficient shows a negative and statistically significant shift in the average growth rate of

Table 2

All Banks
Total Loan Growth Regressions
(1985–1991)

Explanatory Variables	(1)	(2)	(3)
c	4.063 (6.05)**	5.778 (8.53)**	5.741 (8.49)**
$\ln\left(\mathrm{INC}_{i,t}/\mathrm{INC}_{i,t-1}\right)$	1.257 (27.04)**	1.105 (22.74)**	1.104 (22.71)**
$\ln\left(P/L\right)_{i,t-1}$	106.948 (19.15)**	109.806 (19.47)**	109.760 (19.47)**
$\ln\left(L/A\right)_{i,t-1}$	−1.000 (−1.27)	−1.044 (−1.33)	−1.071 (−1.37)
$\ln\left(k_{i,t-1}/k^*_{i,t}\right)$	4.952 (7.10)**	3.718 (4.84)**	2.221 (2.53)*
$D90\text{–}91$		−2.535 (−8.52)**	−1.932 (−4.96)*
$\ln\left(k_{i,t-1}/k^*_{i,t}\right) \cdot D90\text{–}91$			4.373 (2.88)**
$\overline{R^2}$	0.126	0.13	0.131
N	16,261	16,261	16,261

Note: t statistics are in parentheses
* significant at 5 percent level
** significant at 1 percent level

loans in the 1990–1991 period. This result is consistent with the widely held view that bank lending was unusually weak in 1990 and 1991.

To test for a change in the effects of capital regulation, in the third column *D*90-91 is interacted with the log of the ratio of actual leverage to target leverage. The results indicate that the capital position of banks had a positive and statistically significant effect on bank lending even in the second half of the 1980s. This is consistent with other evidence that regulatory policy was emphasizing capital regulation during that period. The connection between capital regulation and bank lending then is not a phenomenon that arose only in the 1990s.

That relationship, however, does appear to have intensified considerably in the past few years. The coefficient for the interacted capital position variable and the dummy variable *D*90-91 is highly significant and points to a relatively large increase in the sensitivity of bank loan growth to capital positions. Overall, the coefficient on the capital position variable is just about three times larger for the period 1990–1991 than for the period 1985–1989. Measured from the average target values, a 0.01 drop in a bank's capital ratio would have lowered its loan growth for a year by an estimated 0.3 of a percentage point during the second half of the 1980s. In the 1990–1991, the same decline in the capital ratio would have led to an estimated 0.8 of a percentage point drop in loan growth.

The finding that bank lending has become more sensitive to capital positions is consistent with a shift to a more stringent regulatory regime in the 1990s.[16] The difference in the coefficient on *D*90-91 between columns (2) and (3) also suggests that the shift in regulatory regime relating to capital regulation may account for part, but not all, of the unusually slow bank loan growth in the 1990 and 1991. The unexplained portion could be due to differences in the behavior of bank lending during recessionary periods, special economic factors such as the condition of the commercial real estate sector, or perhaps more general regulatory influences on bank lending that were not tied directly to capital positions.

Bank Size

To determine how lending may have been affected at different size banks, Table 3 reports pooled cross-section regression results in which separate coefficients are estimated for large and small banks. The coefficients on state income growth indicate that loan growth at small banks is more sensitive to local market conditions. This is not surprising, since bigger banks can be expected to engage in more lending regionally, nationally, and even internationally. Lending by small banks and large banks is about equally sensitive to the quality of loan portfolios.

The effect of the loan-to-asset variable also is different for small and large banks. The effect for small banks is what would be expected for banks with relatively constrained asset/liability management options, such as relying mainly on local, retail deposits. That would make smaller banks with higher loan-to-asset ratios less able to expand lending. The result for smaller banks also is consistent with regulatory policy that tries to constrain nonleverage risk.

For large banks, however, the coefficient for the loan-to-asset ratio is positive, though only marginally significant. One reason for the difference may be that large banks have access to national and even international money and capital markets, so their ability to expand loans is less constrained by the makeup of their existing portfolios. Without this constraint, it may be that the portion of assets invested in loans is an indication of a bank's general investment strategy; banks with high ratios lend more and so tend to have faster loan growth. This is not, however, the relationship that earlier was argued would be expected if this variable were capturing the effects of regulatory policy concerned with controlling nonleverage risk.

The main focus of this analysis is on the effects of capital regulation. The results in Table 3 show that lending by large banks in general is much more sensitive to capital ratios relative to target ratios. This is true even for the 1985–1989 period. In that period, the coefficient for the larger banks is positive and highly significant. In contrast, the coefficient on the capital position variable is positive but not statistically different from 0 for the small bank sample. These results are consistent with the evidence in Table 1 suggesting that capital regulation is more binding for larger banks than it is for smaller banks.

In terms of the shift in regulatory policy, the coefficient on the capital position variable interacted with the shift dummy in the first column of Table 3 suggests that capital regulation has become a factor for small banks in recent years. The point estimate for the increase in sensitivity of lending to capital positions is bigger for the large banks than for the sample of small banks. However, the change for large banks is not statistically significant.

The evidence, then, suggests that the capital regulation has shifted for small banks but perhaps not for larger banks, at least not beyond increases in target capital ratios indicated in Table 1. At the same time, these results suggest that standards under the new capital regulation regime, as

[16]The loan growth equation also was estimated allowing for shifts in the relationship between loan growth and each of the explanatory variables. This had virtually no effect on the change in the coefficient for the capital regulation variable.

under the old, are relatively more binding for the larger banks. Moreover, the larger unexplained decline in loan growth in 1990–1991 for large banks could reflect a shift in regulatory policy toward those banks relative to their smaller counterparts.

Regional Effects

The financial condition of banks varies across geographic regions. The chart, for example, shows that in the early 1990s bank capital positions weakened considerably in New England compared to other regions of the country. The earlier finding of a positive relation between bank capital positions and lending suggests that bank lending should have been more adversely affected in the areas experiencing greater weakness in capital.[17] However, the variation in the financial conditions of banks also raises the possibility that the *shift* in regulatory regime was more pronounced in some geographic regions.

Table 4 presents two sets of statistics relating to the shift in the sensitivity of bank lending to capital positions across regions. The first set consists of estimates from a pooled cross-section time series in which the coefficients in the loan growth equation are constrained to be the same for

[17]In testimony to the U.S. Congress, Richard Syron, President of the Federal Reserve Bank of Boston, argues that the decline in bank capital in the New England area was an important cause of the weakness in lending, and contributed to the so-called credit crunch. See Syron (1991).

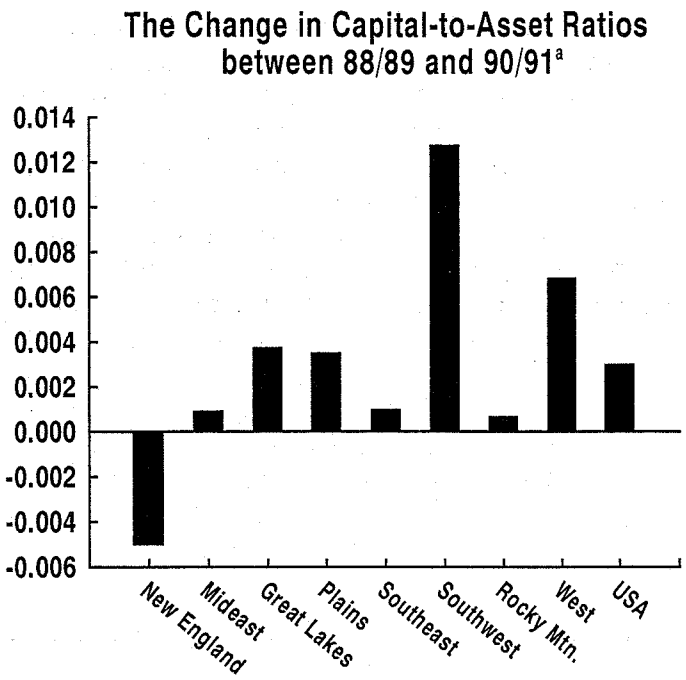
Table 3

Large and Small Banks Total Loan Growth Regressions

(1985–1991)

Explanatory Variables	By Asset Size: $100 million to $1 billion	By Asset Size: $1 billion or more	Difference
c	5.162 (7.20)**	11.238 (6.78)**	−6.076 (−3.36)**
$\ln\left(\mathrm{INC}_{i,t}/\mathrm{INC}_{i,t-1}\right)$	1.138 (22.29)**	0.740 (4.83)**	0.398 (2.47)*
$\ln\left(P/L\right)_{i,t-1}$	110.570 (18.67)**	92.855 (5.61)**	17.715 (1.01)
$\ln\left(L/A\right)_{i,t-1}$	−1.645 (−2.08)**	4.965 (1.78)	−6.610 (−2.28)*
$\ln\left(k_{i,t-1}/k^*_{i,t}\right)$	1.081 (1.33)	13.100 (2.78)**	−12.019 (−2.53)*
$D90\text{–}91$	−1.838 (−5.90)**	−4.929 (−2.72)**	3.091 (1.68)
$\ln\left(k_{i,t-1}/k^*_{i,t}\right) \cdot D90\text{–}91$	3.680 (3.03)**	5.574 (0.70)	−1.894 (−0.43)
$\overline{R^2}$	0.137		
N	16,261		

Note: See note to Table 2.



[a]The difference between the average of the quarterly data 1988/89 and 1990/91

banks in all regions, with the exceptions of the dummy variable *D*90-91 and the capital position variable interacted with the dummy. To simplify the presentation, only the figures measuring the shifts in the intercept and the coefficient on the capital position variable are reported. The geographic regions correspond to the Bureau of Economic Analysis definitions.[18]

The results suggest that the change in sensitivity of bank lending to capital positions may have been more pronounced in some regions. Only three of the eight regions show statistically significant increases, with the largest change for the New England region. However, some shift also may have occurred in the other regions. For example, when the five regions not showing statistically significant results in the second column of Table 4 are grouped together, we can reject the hypothesis of no change in the loan growth/capital position relationships after 1989.

In the pooled regression for all banks, it is possible that systematic differences among regions prior to 1990 affected the measured shifts in the loan growth equation. Accordingly, the second set of statistics in Table 4 is based on separate cross-section time series regressions for each region. Overall, the results show somewhat more evidence of a shift in the effect of banks' capital positions than do the results for the pooled regression for all banks. The three regions showing significant positive shifts in the coefficient for the capital position variable in the first set of statistics also do so in the second set. One additional region showing a shift in the loan growth/capital position relationship is the Southeast. Another difference is that the Great Lakes region shows a marginally significant increase in the response of bank lending to capital positions in the separate regression for that region.

The separate regressions still suggest regional differences in the shift in regulatory policy, again with the New England region showing the largest increases in the sensitivity of bank lending to capital positions. These results, coupled with the data on the decline in capital positions, highlight why the credit crunch in 1990–1991 is most closely associated with developments in New England. That region shows the largest decline in bank capital ratios and the biggest increase in the sensitivity of lending to capital positions in the 1990–1991 period.

The results for the Southwest region provide an interesting comparison with those for the New England region. The separate regression for the Southwest shows neither a significant shift in the relationship between loan growth and bank capital positions nor a negative intercept shift in the loan growth equation after 1989. This may reflect the improvement in capital positions of banks in the Southwest as illustrated in the chart. More likely, these results reflect the difference in timing of the problems hitting the banks in the Southwest. In that region, the problems in the banking industry hit in the 1980s. As a result, bank loan growth in the Southwest was already weak going into the 1990s. The weakness in banking lending in the Southwest in the 1990–1991 period is reflected in the significant negative shift in intercept in the first column of Table 4.

The evidence for the West also is interesting since it suggests that bank lending became less sensitive to capital positions in the 1990–1991 period. Indeed, with the change in the sensitivity during the 1990–1991 period, the overall effect of bank capital positions on lending was not statistically significant for the West. This does not necessarily mean that the region was unaffected by regulatory policy, however. The regression results for the West do indicate a significant downward shift in loan growth in 1990–1991, which leaves open the possibility that regulatory policy affected lending in the region. It is still possible that regulatory policy had a dampening effect on lending; it is just not evident that such influences were systematically related to the bank capital positions in the area.

IV. Conclusion

This paper finds that loan growth for individual banks is positively related to their capital-to-asset ratios. The analysis in this paper goes beyond that of previous studies by

[18]Alaska and Hawaii are included in the West.

using a much broader sample of banks and examining how the relation between capital positions and lending has changed in recent years. The analysis shows increases in both bank capital standards and in the sensitivity of bank lending to capital positions in the early 1990s compared with the second half of the 1980s. The apparent shift in regulatory regime affected small banks as well as large banks. The overall sensitivity of lending to capital positions was more pronounced during both periods for the large banks in the sample. This result is consistent with the view that capital regulation tends to be binding more often for larger banks than for smaller banks. The change in the sensitivity of bank lending to capital positions varies regionally, with the New England region being the most affected.

With regard to the so-called credit crunch in the 1990s, the findings in this paper support the view that the increase in effective capital standards and the actual decline in capital positions of some banks contributed to slow loan growth in the 1990–1991 period. In addition, the increased sensitivity of bank lending to capital positions accounts for a portion of slower than normal bank loan growth in the 1990–1991 period. The impact of capital regulation on lending likely was most pronounced in the New England region, which experienced both the greatest decline in bank capital ratios and the sharpest rise in sensitivity of

Table 4

Regional Effects
Total Loan Growth Regression
(1985–1991)

	Pooled Regression For All Banks		Separate Regressions by Region			
	D90–91	$\ln(k_{i,t-1}/k^*_{i,t})$ • *D90–91*	*D90–91*	$\ln(k_{i,t-1}/k^*_{i,t})$ • *D90–91*	$\bar{R}^2$	*N*
New England	1.324	14.966	−5.300	20.53	0.311	790
	(1.09)	(4.88)**	(−1.44)	(3.31)**		
Mideast	−0.665	5.143	−6.079	4.310	0.118	2504
	(−0.61)	(1.20)	(−4.62)**	(0.90)		
Great Lakes	−1.205	3.044	−2.367	5.328	0.082	4104
	(−1.73)	(1.01)	(−3.27)	(1.62)		
Plains	−1.697	8.241	−0.281	9.783	0.103	1604
	(−2.48)*	(3.22)**	(−0.36)	(3.42)**		
Southeast	−3.586	1.724	−4.244	6.00	0.186	3597
	(−8.46)**	(1.09)	(−8.84)**	(3.59)**		
Southwest	−4.419	3.839	2.116	4.297	0.100	1924
	(−2.73)**	(1.09)	(1.14)	(1.12)		
Rocky Mtn.	−4.900	12.155	1.279	13.68	0.156	529
	(−2.65)**	(2.58)**	(0.63)	(2.71)**		
West	0.521	−4.717	−4.538	−12.742	.063	1209
	(0.38)	(−0.95)	(−2.52)*	(−1.82)‡		
$\bar{R}^2$		0.135				
N		16,261				

NOTE: See note to Table 2.

lending to bank capital positions. For banks nationally, however, a good portion of the slower loan growth in 1990–1991 is not accounted for directly by movements in capital positions or by changes in capital regulation. The unexplained portion may be due to the difference in the behavior of the supply and the demand of bank loans during recessionary periods, special economic factors such as the condition of the commercial real estate sector, or perhaps more general regulatory influences on bank lending that were not tied systematically to capital positions.

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