The Capital Crunch: Neither a Borrower Nor a Lender Be

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Abstract

The dramatic reduction in the growth rate of bank lending associated with the 1990-91 recession, particularly in New England, has evoked claims by many observers of a credit crunch. However, because of the difficulty in determining whether the observed slow credit growth is a demand or supply phenomenon, convincing evidence of the practical importance of credit crunches for economic activity remains elusive. We overcome this obstacle by examining a cross-section of banks in New England that have experienced the same economic downturn, effectively controlling for changes in demand. We find empirical support for a capital crunch, whereby poorly capitalized institutions shrink to satisfy capital requirements. This alone is not a sufficient condition for a credit crunch. However, we find some additional evidence that the capital crunch may have limited credit availability in New England.

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asymmetric information and the lemons problem (for example, Myers-Majluf 1984). Because managers have no incentive to disclose problems in their asset portfolio, potential equity holders, concerned that only problem banks would be willing to dilute the shares of current equity owners, refuse to buy new stock issues at a price providing "normal" economic returns. Thus, new equity cannot be issued at a price that management and current shareholders deem reasonable, leaving shrinkage as the only feasible alternative for troubled banks to satisfy binding capital requirements. In fact, in our sample of New England banks many have chosen to shrink.

For problems in the banking sector to extend to the real economy, banks must provide a service that is not easily provided by alternative financial intermediaries. While alternatives to bank financing are available for large borrowers, most small and medium-sized businesses depend on banks for financing. Banks specialize in this segment, where most information is private rather than public; where the industry, management skills, and local conditions may be critical to the determination of credit-worthiness; and where lending institutions can achieve economies of scope in monitoring the lender. Because of this asymmetry in information, most small and medium-sized businesses find banks the only economical source of debt financing (see, for example, Stiglitz and Weiss 1981; Elliehausen and Wolken 1990; and Kashyap, Stein and Wilcox 1991).

The purpose of this paper is to document that the recent reduction in bank capital has caused New England banks to shrink. Using a theoretical model, we document how bank behavior can be altered by binding capital regulations. Then, controlling for demand, we find empirical evidence supporting the hypothesis that New England banks have experienced a capital

crunch. We also provide some suggestive evidence that bank shrinkage has, in fact, reduced bank lending. If asymmetric information is important and if the costs of acquiring information and monitoring loans are large, then a capital crunch may cause a decline in lending that is not filled by other lenders, that is, a credit crunch.

The first section of this paper summarizes recent banking conditions in New England. It shows that banks experienced large reductions in capital during a period when capital regulation became increasingly important. The second section provides a theoretical model, which verifies that a loss of bank capital resulting in binding capital requirements will cause a bank to behave differently than it would if the requirements were not binding. The model also documents that binding capital requirements can best be ascertained by examining the liabilities of a bank rather than the assets. We therefore focus on liabilities in our empirical section, in contrast to most previous work which has focused on bank assets (for example, Bernanke and Lown 1991 and King 1986). We control for loan demand by limiting our empirical analysis to a cross-section of banks in a single region that faced the same economic downturn.

Our study concludes that bank behavior in New England was altered by the loss of capital. Poorly capitalized banks shrank both their liabilities and assets more than their better capitalized competitors, with the deposit reductions occurring in the marginal and most expensive accounts rather than across the board, as might occur if the deposit shrinkage were initiated by depositors. We also find evidence of a positive relationship between total loan growth and the capital/asset ratio. Thus, controlling for any general weakness in loan demand, we find substantial empirical support for a capital

crunch in New England, and more limited support for the credit crunch hypothesis.

I. Background

Our study focuses on New England because it was the first region to have substantial losses of capital during a period when capital regulations were actively enforced. The adoption of international capital requirements and the attention given to the savings and loan debacle have made bankers, regulators, and politicians acutely sensitive to capital regulation. If we cannot find evidence of a capital crunch in New England during the recent economic downturn, it is unlikely to be a problem elsewhere.

The loss of bank capital in New England had its roots in the previous decade. After experiencing losses on Third World loans, oil industry loans, and farm loans, many banks decided to focus on their local market. The rapid rise in real estate prices, combined with the widely held perception that nominal prices might flatten but were unlikely to fall, caused New England banks between 1984 and 1988 to expand real estate loans fourfold, almost twice the rate of banks nationwide. When nominal real estate prices began to fall in New England, banks experienced a sharp increase in nonperforming assets, which grew from approximately $3 billion at the end of 1987 to approximately $17 billion by the end of 1990, of which 79 percent were real estate loans. These nonperforming loans seriously eroded capital ratios.

Table 1 summarizes balance sheet statistics for banks in our sample. We define as large any institution with assets that exceed $300 million, consistent with call report classifications. We also separate savings and commercial banks, because savings banks have historically had fewer commercial

Table 1
New England Bank Balance Sheet Statistics
1990:1 - 1991:1

	Large Commercial Banks	Large Savings Banks	Small Commercial Banks	Small Savings Banks
Change in assets ($ billions)	-16.1	-5.0	0.5	0.4
Change in equity ($ billions)	-0.5	-1.4	-0.1	-0.1
% Change in assets (91:1/90:1)	-10.1	-7.6	3.0	2.1
% Change in equity (91:1/90:1)	-5.9	-28.2	-10.5	-4.7
Capital/Assets 90:1	5.2	7.6	8.0	9.3
Capital/Assets 91:1	5.4	5.9	7.0	8.7
% Non-performing Assets 90:1	5.0	5.6	2.7	3.1
% Non-performing Assets 91:1	7.4	8.7	5.5	4.6
Number of banks	49	82	150	141
Percentage of banks shrinking (Assets 91:1/Assets 90:1)	71	63	37	25

and industrial loans, although no legal impediments remain to prevent them from making such loans. (The sample is described more completely in the empirical section of this paper.)

The largest reduction in assets occurred in the large commercial banks category. From the first quarter of 1990, when the extent of the problems at Bank of New England first became apparent, to the first quarter of 1991, large commercial bank equity fell by $500 million. At the same time, assets dropped by $16 billion. The large drop in assets was likely due to the low capital ratios maintained by large commercial banks before the collapse in real estate prices, and to their inability to raise new capital in the depressed market. In fact, the decline in assets was so large that the capital/asset ratio actually increased over the period. Compared to large commercial banks, large savings banks had nearly three times as large a reduction in equity, yet their decrease in assets was less than one-third the size. This is likely related to the higher initial capital ratios of the savings banks.

The smaller institutions had much smaller percentage declines in equity and actually had asset growth during the period. Much higher initial capital positions and smaller proportions of non-performing loans enabled the smaller institutions to avoid many of the problems experienced by the larger banks.

A large number of New England banks shrank during this period. For example, among large commercial banks and large savings banks in our sample, 71% and 63%, respectively, actually shrank. Even among the less affected smaller institutions, at least one-quarter of their number were downsizing.

While this shrinkage of institutions is consistent with a capital crunch, it is also consistent with a slower economy. During economic downturns it is not surprising that some banks shrink. And if large

commercial and industrial loans are most severely affected by the downturn, the larger banks would experience the most severe problems. While the number of institutions shrinking is quite large, the economic downturn was severe in New England and banks had already been experiencing a sectoral decline as other intermediaries infringed on their traditional lending markets. It is the purpose of the theoretical and empirical sections of this paper to determine if, after controlling for demand factors, the capital crunch was an important factor affecting bank behavior in New England.

II. A Simple Model of Banks

To establish why a capital crunch may have been important in New England in 1990, we provide a highly simplified one-period model of the banking firm.[2] Each relationship has been linearized and written such that all parameters are assumed to be positive. The bank is assumed to have only two assets, bank reserves (R) and loans (L), and two liabilities, bank capital (K) and deposits (D). Thus, for simplicity we are ignoring the myriad of issues related to asset and liability management by banks.

The balance sheet constraint requires that total assets must equal total liabilities. Furthermore, banks must hold reserves equal to their reserve requirement ratio (α) times their outstanding deposits.[3]

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[2] We chose a one-period model to provide the simplest framework to illustrate the importance of capital. (For a more complete description of how capital requirements affect bank behavior see Osterberg (1990)). In a dynamic model, one would need to model when equity was issued, dividend policy, and the relation between current loans and future loan losses. While these additions would provide a richer model, they would not alter our fundamental results.

[3] In reality, banks must hold reserve requirements only on their transactions accounts. The current reserve requirement is 3 percent on net transactions accounts up to $41.1 million and 12 percent on net transactions accounts above $41.1 million. However, the first $3.4 million of reservable

(1) $R+L=K+D$

(2) $R=\alpha D$

Banks can expand deposits by offering interest rates on deposits greater than the mean deposit rate in their market ($\overline{r_D}$), and loans decrease as the bank offers a loan rate higher than the mean loan rate in their market ($\overline{r_L}$).[4]

(3) $D=f_0+f_1(r_D-\overline{r_D})$

(4) $L=g_0-g_1(r_L-\overline{r_L})$

Finally, bank behavior may be further constrained by the required capital/asset ratio (μ).

(5) $K = \mu(R+L)$

The bank is assumed to maximize profits (π). Because our profit function abstracts from fee income and overhead costs, total profits are simply the difference between interest income on loans ($r_L L$) net of loan losses (ϕL) and interest paid on deposits ($r_D D$).

(6) $\pi=(r_L-\phi)L-r_D D$

Using (1)-(4) to eliminate R, L, r_L and r_D from (5) and (6), the maximization problem can be stated as the following Lagrangian, with Lagrangian multiplier λ associated with the capital ratio constraint.

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liabilities have a zero percent reserve requirement. It is assumed in the model that banks do not hold excess reserves. This assumption is minor since most banks avoid holding excess reserves.

[4] This model ignores the uncertainty associated with shocks to deposit and loan flows. Because we have only one asset other than reserves in this simple model, we do not consider the many interesting issues involving portfolio composition.

$$(7)\quad Max\ \pi=\frac{[-(1-\alpha)D-K+g_0+g_1\overline{r_L}-g_1\phi]\,[(1-\alpha)D+K]}{g_1}$$

$$-\frac{(D-f_0+f_1\overline{r_D})D}{f_1}+\lambda\,[K-\mu\,(K+D)\,]$$

When the capital ratio is not binding, $\lambda=0$, and the profit function is unconstrained.

Choosing D to maximize profits results in the two first-order conditions:[5]

$$(8)\quad \frac{d\pi}{dD}=\frac{[-(1-\alpha)D-K+g_0+g_1\overline{r_L}-g_1\phi]\,(1-\alpha)}{g_1}-\frac{[(1-\alpha)D+K]\,(1-\alpha)}{g_1}$$

$$-\frac{(D-f_0+f_1\overline{r_D})}{f_1}-\frac{D}{f_1}-\lambda\mu=0$$

and

$$(9)\quad \frac{d\pi}{d\lambda}=(1-\mu)K-\mu D=0$$

For $\lambda\neq0$, we can solve for D directly from (9):

$$(10)\quad D=\frac{1-\mu}{\mu}K$$

When $\lambda=0$, the level of D can be obtained directly from (8):

$$(11)\quad D=\frac{-2(1-\alpha)f_1K+(1-\alpha)f_1(g_0+g_1\overline{r_L}-g_1\phi)+f_0g_1-f_1g_1\overline{r_D}}{2(1-\alpha)^2f_1+2g_1}$$

Thus, when bank behavior is not constrained by binding capital requirements, a reduction in capital increases deposits:

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[5] Of course, banks choose the level of deposits by choosing r_D. However, because we are interested in deposits rather than r_D, it is more direct to state the optimization problem in terms of choosing D.

$$(12)\quad \frac{dD}{dK}=\frac{-(1-\alpha)f_1}{(1-\alpha)^2 f_1+g_1}<0$$

And, using (1) and (2), it can be seen that loans would fall, but by less than dollar for dollar:

$$(13)\quad \frac{dL}{dK}=\frac{g_1}{(1-\alpha)^2 f_1+g_1}>0 \quad but\ <1$$

When faced with an adverse shock to their capital, banks could shrink loans dollar for dollar. However, this would require them to forgo profitable loans. Thus, banks increase deposits to replace at least some of their lost capital. However, given (3), this entails an increased cost of deposits. At the same time, the more loans shrink, the higher is the return to loans. The slower the return to loans falls (larger is g_1) and the faster the cost of deposits rises (smaller is f_1), the larger the decline in loans.

The bank reacts very differently to a loss of capital if the capital ratio is binding ($\lambda \neq 0$). In this case, both deposits and loans decrease.

$$(14)\quad \frac{dD}{dK}=\frac{(1-\mu)}{\mu}>0$$

$$(15)\quad \frac{dL}{dK}=\frac{(1-\alpha+\alpha\mu)}{\mu}>0$$

The decline in K forces a proportional decline in D. The binding capital ratio prevents deposits being substituted for the lost capital as in the previous example. With both K and D declining and the decline in R being less than that in D, loans must decline. Note that only the capital requirement matters for the bank deposits reaction in the constrained case, while the reserve requirement and the interest sensitivities of both deposits and loans

(and not the capital constraint) affect the deposits reaction in the unconstrained case. The determinants of the change in loans differ similarly, being solely a function of the capital requirement and the reserve requirement in the constrained case.

With both D and K declining in the capital constrained case, total liabilities, and hence total assets, unequivocally decline.

$$(16) \quad \frac{d(K+D)}{dK} = \frac{d(R+L)}{dK} = \frac{1}{\mu} > 1$$

However, in the unconstrained case total assets and liabilities may rise or fall:

$$(17) \quad \frac{d(K+D)}{dK} = \frac{d(R+L)}{dK} = \frac{-\alpha(1-\alpha)f_1+g_1}{(1-\alpha)^2 f_1+g_1} < 1$$

Whether the bank shrinks or grows when K declines depends on the relative magnitudes of α, g_1, and f_1, with growth more likely the larger is g_1 and the smaller are f_1 and α (given the likely range of values for α).[6] Equations (16) and (17) show that a decline in bank capital will cause banks facing binding capital constraints to shrink by more than those institutions not so constrained. That is, when a negative capital shock occurs, the degree of shrinkage is a function of the bank's capital/asset ratio.

This simple model illustrates why the capital crunch may be a recent phenomenon. A large negative shock to capital is a necessary but not a sufficient condition for a capital crunch. Banks definitely shrink only if the capital requirements are binding. If capital remains well above the minimum required, or if regulatory authorities do not enforce capital

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[6] The conditions required for (17) to be negative are the same as those that make $dD/dK < -1$ in (12).

requirements, the bank will shrink by less and may even grow. Therefore, the experience in New England may be different from previous episodes, when the regulatory authorities did not strictly enforce capital regulations. For example, when Third World loans began to default in the early 1980s, regulatory authorities practiced forbearance. And, during the savings and loan debacle, regulators not only practiced forbearance but also allowed accounting gimmicks to prop up capital.

A second reason capital requirements have recently affected bank behavior is the adoption of international risk-based capital standards as a result of the December 1987 Basel Accord. In addition, regulators have supplemented the risk-based capital standard with a minimum leverage ratio. The adoption of new capital ratios, accompanied by a realization of the huge costs resulting from the earlier lax regulation of the savings and loan industry, has placed pressure on Congress and regulators to rigorously enforce banking regulations.

The model has several important implications for the empirical analysis. First, it shows that negative capital shocks will cause banks to shrink if the capital ratio becomes binding. Second, it suggests that deposits rather than loans may be the more appropriate indicator for capital crunch tests because an adverse shock to capital causes loans to decline whether or not the capital constraint is binding, while deposits decline with an adverse capital shock only if capital is constrained. Finally, the size of the capital lost on real estate loans in New England banks, combined with the recent rigorous enforcement of capital regulations, makes likely the conditions for a capital crunch described in the model, namely large capital losses and binding capital regulations.

III. Empirical Evidence of a Capital Crunch

Empirical investigations of credit crunches have been hampered by the difficulty in separating the decrease in the demand for loans that normally occurs in a recession from the diminished supply of loans. We avoid this problem by focusing on a cross-section of banks that were all subject to the same regional economic downturn. If decreases in assets and liabilities of banks during recessions were solely due to decreased demand, all banks should shrink by similar proportions.[7] If, however, the capital crunch hypothesis is correct, shrinkage of liabilities and assets should be greater, the lower the capital/asset ratio of the bank.

The Data

We examine a sample of commercial banks and savings banks in New England from the first quarter of 1990 to the first quarter of 1991. The first quarter of 1990 was chosen as the starting date for several reasons. First, the most recent data available were from the first quarter of 1991 and the change in assets and liabilities must be calculated over multiples of four quarters to avoid distortions due to seasonal factors. Second, choosing a relatively short window limits the distortions that occur with bank mergers and failures. Finally, in the first quarter of 1990 bank examiners found substantial problems in the Bank of New England's real estate portfolio. This caused other banks (and examiners) to reexamine their own institutions.

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[7] Of course, banks being subject to the same economic downturn is not equivalent to being subject to identical demand shocks. However, by limiting our sample to a single Federal Reserve district rather than the nation, the range of the demand shocks is much more limited. In our estimated equations, we attempt to allow for differences in demand shocks across banks in our sample due to different types of banking activities.

Because the balance sheet data collected by the Office of Thrift Supervision (OTS) are not consistent with those collected by the Federal Deposit Insurance Corporation (FDIC), savings and loans are not included in our sample. Fortunately for this study, savings and loans play a much smaller role in New England than they do elsewhere in the country.[8]

Several types of institutions were dropped because their capital or liabilities radically differed from most banks in the sample.[9] Banks that opened after January 1, 1989, were dropped from the sample because new banks start with 100 percent capital and then, as they begin to make loans, expand much more rapidly than mature banks. Inclusion of these banks would have made the link between capital and expansion appear much stronger than was appropriate for institutions not newly formed. In addition, institutions with either no loan losses or no nonperforming loans were dropped for essentially the same reason: they were recently formed banks just beginning to make loans. Institutions with no commercial and industrial loans or no demand deposits, such as cooperative banks and nonbank banks, also were dropped. Generally, this latter type of institution has large securities operations but is not actively involved in loan origination, which is the focus of the problems with credit availability.

Failed institutions also presented a problem. Liquidated institutions were eliminated from the sample because their end-of-period balance sheet is zero. Inclusion would have biased the results toward finding a relationship

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[8] OTS-supervised institutions comprise only 6.6 percent of the total assets of New England depository institutions.

[9] In addition to those deletions mentioned in the text, we eliminated one small commercial bank that consistently maintained a capital/asset ratio in excess of 25 percent, over three times the mean capital/asset ratio of the sample.

between capital and bank shrinkage that represented insolvency rather than changes in bank behavior. Failed institutions acquired by OTS-supervised institutions were dropped because comparable end-of-period data were not available. Banks that merged with failed OTS-supervised institutions also were dropped because beginning-of-period data on the acquired institutions were not available.

All other institutions, a sample of mature commercial banks and savings banks, remained in the sample. Institutions that merged between January 1989 and the first quarter of 1991 were combined into a single institution for our sample. That is, they were treated as if the merger were consummated at the beginning rather than in the middle of our sample period. Otherwise, merged institutions would have to be dropped and acquiring institutions would experience large increases in liabilities due to the acquisition. A separate file of institutions not involved in acquisitions was maintained to ensure that this assumption did not significantly affect our results.[10]

Another potential problem is the definition of capital. Capital regulation includes a variety of definitions, which use different measures of capital, different measures of assets, and different treatments of intangible assets.[11] Rather than attempt to test all the different definitions of

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[10] The full sample included 420 banks: 49 large commercial banks, 149 small commercial banks, 82 large savings banks, and 140 small savings banks. After excluding those banks that merged with institutions outside of their holding company during the 1989-1990 period, the sample size was reduced to 404 banks. We obtained essentially the same empirical results with this "clean" sample.

[11] The risk-based ratios are 8 percent for the ratio of total capital to risk-weighted assets and 4 percent for tier 1 capital to risk-weighted assets. The leverage ratio is 3 percent of tier 1 capital to total assets for banks with a CAMEL rating of 1. All other banks are expected to maintain capital 100 to 200 basis points above the minimum. Core capital consists of common equity, qualifying preferred stock, and minority interest in consolidated subsidiaries less goodwill. In practice, core capital is frequently calculated net of all

capital, we have used total equity capital divided by total assets. This definition most closely conforms to the leverage ratio, the capital standard that is generally the most binding on banks.[12]

Banks have some latitude in classifying and reserving for loan losses (Walter 1991). Consequently, we also calculate a measure of capital that controls for differences in banks' willingness to reserve on their nonperforming loans. Some banks, with very large nonperforming loan portfolios and very small loan loss reserves, have overstated their current capital because they have yet to realize (in an accounting sense) the deterioration in their loan portfolio. Equation (18) provides an adjusted capital ratio to account for differences across banks in reserving for nonperforming assets. This attempts to put all banks in our sample on an equal footing by taking into account each bank's discretion in setting aside loan loss reserves.

$$(18) \quad adjK_i = K_i + (1 - \frac{\beta_i}{\bar{\beta}}) LLR_i$$

where

$$\beta_i = \frac{NP_i}{LLR_i}$$

$$\bar{\beta} = \frac{\sum NP_i}{\sum LLR_i}$$

NP_i = nonperforming loans for bank i

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intangible assets.

[12] As of June 30, 1991, of the 20 largest First District commercial and savings banks, none violated tier 1 risk-based guidelines, seven violated total risk-based guidelines, and nine violated a 5 percent leverage ratio.

LLR_i = loan loss reserves for bank i

If nonperforming loans relative to loan loss reserves for bank i are large relative to those of comparable banks, bank i's capital is decreased to adjust for this difference.[13] Similarly, banks that have lower than average nonperforming loans relative to loan loss reserves have adjusted capital that exceeds reported capital. To maintain a consistent balance sheet account, the same capital adjustment was also added to total assets. All our results are reported with and without the capital adjustment.

The Empirical Test

The capital crunch hypothesis predicts that poorly capitalized institutions will shrink deposits more rapidly than better capitalized institutions, holding the loan demand effects of the regional economy constant. We test this by estimating the following equation.

$$(19) \quad DEP_i = a_0 + a_1 \frac{K_i}{A_i} + a_2 A_i + a_3 FEE_i + a_4 CI_i + a_5 RE_i + \epsilon_i$$

The dependent variable is the percentage change in total deposits (DEP) from the first quarter of 1990 to the first quarter of 1991.[14] The beginning-of-period capital to asset ratio (K/A) is calculated using first quarter 1990 data for total equity and assets.

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[13] For purposes of calculating adjusted capital, we divided our sample into four categories of banks: large commercial, small commercial, large savings, and small savings. An average loan loss provision was then calculated for each set of comparable institutions and used to adjust the capital of each bank in that category. For the first quarter of 1990, the average ratios of nonperforming loans to loan loss reserves were: large commercial banks, 1.53; small commercial banks, 2.28; large savings banks, 2.71; small savings banks, 3.94.

[14] This measure is calculated as a bank's total liabilities excluding its total equity, which is composed primarily but not exclusively of deposits.

By limiting our sample to New England banks, we control for many of the differences in loan demand faced by banks generally. However, it is possible that banks specializing in particular types of loans may experience different demand shocks. We try to control for possible differences in demand factors faced by banks by including several variables that might capture differences in lending opportunities. The first is the logarithm of asset size (A). Banks are constrained not to lend more than 10 percent of their capital to any one borrower. This constraint would prevent many smaller institutions from making large loans. If the demand conditions vary by size of borrower, we may see very different deposit growth rates by size of institution.

Another factor that may distinguish among banks is that those with large off-balance-sheet activities may be better insulated from changes in demand than banks that focus on lending. To control for this possibility, we include the ratio of fee income to the sum of total interest and fee income (FEE) for calendar year 1989. Demand shocks may also affect different types of lending activity unevenly. We include the ratio of commercial and industrial loans to total assets (CI) and the ratio of real estate loans to total assets (RE) held in a bank's portfolio in 1989 in order to control for banks with a large exposure to a sector that might be disproportionately affected by an economic downturn.

We further segment our sample in order to try to verify that we have controlled for possible differences across banks in the degree to which they are affected by demand shocks. Because New England savings banks have generally been less active in lending to businesses, we categorize institutions by whether they have a commercial or savings bank charter. This provides a further check on whether CI captures differences in demand shocks

across institutions. We further split the sample into large bank and small bank categories. Large is defined as any institution with at least $300 million in assets, consistent with the classification used in call reports.

Tables 2 and 3 report the results of estimating equation (19) for all banks and for the four subcategories: large commercial banks, large savings banks, small commercial banks, and small savings banks. Table 2 uses unadjusted capital and Table 3 uses adjusted capital. We allow for the possibility of heteroskedasticity in the error term using a White correction (White 1980).

The results provide substantial support for the capital crunch hypothesis. Capital ratios are a statistically significant determinant of deposit growth in each of the regressions, with the estimated capital ratio coefficient significant at the 1 percent confidence level in the large savings banks and the all-banks samples. Furthermore, the magnitudes of the estimated capital ratio coefficients are of roughly the same magnitude for the corresponding regressions in Tables 2 and 3, with the most pronounced difference occurring in the large commercial bank regressions. A 1 percentage point decrease in a bank's capital/asset ratio corresponds to a more than 1 percent decline in its deposit growth rate for the all-banks sample and an even more dramatic 1 and one-half percent drop for the large commercial banks sample. Our results are not sensitive to the adjustment to capital for differences across banks in reserving for nonperforming loans.

Asset size has a negative estimated coefficient in each regression, with eight of the 10 coefficients being statistically significant, seven at the 1% confidence level. Only in the small commercial bank sample is the effect insignificant. Fee income has a positive sign in eight of the 10 regressions,

Table 2
Determinants of the Percentage Change in Total Bank Deposits[1,2]
1990:1 - 1991:1

	Constant	K/A	Assets	FEE	C&I	RE	n	$\bar{R}^2$	SEE
Large Commercial Banks	.21	1.47*	-.02*	.29	.02	-.09	49	.15	.080
	(.17)	(.72)	(.01)	(.17)	(.06)	(.08)			
Small Commercial Banks	.19	.91*	-.01	.07	-.09	-.05	149	.03	.119
	(.18)	(.46)	(.02)	(.25)	(.09)	(.12)			
Large Savings Banks	.56**	.99**	-.05**	-.33	-.08	.03	82	.49	.056
	(.15)	(.19)	(.01)	(.24)	(.08)	(.06)			
Small Savings Banks	.55**	1.15*	-.04**	.43	-.03	-.19*	140	.17	.083
	(.14)	(.50)	(.01)	(.57)	(.12)	(.08)			
All Banks	.36**	1.06**	-.03**	.10	-.04	-.08	420	.24	.093
	(.06)	(.21)	(.00)	(.14)	(.04)	(.04)			

[1]Total bank deposits are defined here as total bank liabilities less bank capital.
[2]Estimated with a White correction for heteroskedasticity, standard errors in parentheses.
*Significant at 5% confidence level
**Significant at 1% confidence level

Table 3
Determinants of the Percentage Change in Total Bank Deposits [1,2]
1990:1 - 1991:1

	Constant	Adj. K/A	Assets	FEE	C&I	RE	n	$\bar{R}^2$	SEE
Large Commercial Banks	.21	1.60*	-.03**	.32	.05	-.03	49	.19	.078
	(.16)	(.61)	(.01)	(.18)	(.06)	(.08)			
Small Commercial Banks	.16	.98*	-.01	.04	-.09	-.04	149	.04	.118
	(.17)	(.45)	(.02)	(.24)	(.09)	(.12)			
Large Savings Banks	.60**	.92**	-.05**	-.36	-.08	.02	82	.48	.056
	(.15)	(.20)	(.01)	(.24)	(.08)	(.06)			
Small Savings Banks	.56**	1.13*	-.04**	.39	-.02	-.18*	140	.16	.083
	(.14)	(.51)	(.01)	(.56)	(.12)	(.08)			
All Banks	.35**	1.04**	-.03**	.10	-.02	-.06	420	.24	.093
	(.06)	(.20)	(.00)	(.14)	(.04)	(.04)			

[1]Total bank deposits are defined here as total bank liabilities less bank capital.
[2]Estimated with a White correction for heteroskedasticity, standard errors in parentheses.
*Significant at a 5% confidence level
**Significant at a 1% confidence level

although none are statistically significant. This is consistent with the hypothesis that banks relying heavily on fee income were more insulated from the recent demand shocks. Banks with substantial commercial and industrial loans and real estate loans do not appear to have experienced significantly different demand shocks, with real estate loans having a statistically significant effect only in the small savings bank sample. However, in eight out of 10 cases estimated coefficients have a negative sign, suggesting that institutions with large holdings of commercial and industrial loans and real estate loans were subjected to stronger demand shocks during this period.

Tables 2 and 3 support the capital crunch hypothesis: institutions with lower capital ratios grew more slowly (shrank more rapidly) to try to satisfy capital requirements. Furthermore, the results are fairly consistent across types and sizes of banks.[15] The next section examines how the decrease was distributed across categories of deposits.

Composition of Deposit Growth

If difficulty in meeting capital requirements, rather than weak demand, accounts for the shrinkage of poorly capitalized institutions, the shrinkage should not be uniform across deposit categories. Presumably, banks will choose to shrink those accounts that are most expensive, while trying to leave unchanged deposits that provide low-cost funds. We examine three categories of deposits: NOW accounts, MMDA accounts, and large certificates of deposit (CDs). The average interest rates paid nationally in 1990 for these accounts were 4.58%, 6.29%, and 7.99%, respectively (Brunner, Duca, and McLaughlin

[15] F-tests cannot reject combining large with small commercial banks, large with small savings banks, or small commercial banks with small savings banks. However, the data do reject at the 5% significance level the combination of large commercial banks with large savings banks, as well as the combination of all four subcategories into the all-banks aggregate.

1991). While differences in the cost of maintaining and reserving these accounts may be responsible for some of these differences, their cost ranking is unlikely to be changed by including all the other costs associated with these accounts. Because CDs tend to be the marginal source of funds, we anticipate an even stronger response to capital/asset ratios in the CD equation relative to those in the NOW and MMDA equations.

We have re-estimated equation (19) with growth rates by deposit category replacing the growth rate of total deposits. The results indicating the sensitivity of deposit growth to a bank's capital position are reported in Table 4. The capital crunch hypothesis would imply that the capital/asset ratio would have a larger positive sign the more costly the deposit account and the more the deposit type serves as the marginal source of funds. For ease of presentation, we have omitted from the table the estimated coefficients of the variables included in the regressions that control for bank characteristics.

The results in Table 4 support the hypothesis that banks have been reducing the most costly accounts. For the all-banks category, large CDs have an estimated coefficient twice the size of either of the less costly accounts and the coefficient is significant at the 1 percent confidence level. While capital ratios have a statistically significant effect on MMDA growth in the all-banks sample, their effect is not significant for NOW accounts. Furthermore, although MMDA and NOW accounts have similar sized responses, the MMDA response is measured with much greater precision.

Based on the adjusted capital measure, the point estimate of the sensitivity of large CD growth to the capital ratio is greater than that for MMDA accounts in all but the small commercial bank category. In three of the

Table 4
The Effect of Capital/Asset Ratios on Deposit Growth by Category[1]
1990:1 - 1991:1

	Deposit Category					
	Unadjusted Capital			Adjusted Capital		
	NOW	MMDA	Large CD	NOW	MMDA	Large CD
Large Commercial Banks	4.14**	4.61	7.77*	3.02**	4.26*	7.43*
	(1.06)	(2.41)	(3.62)	(.98)	(1.85)	(3.11)
Small Commercial Banks	6.49	3.91**	3.16**	6.05	4.26**	3.89**
	(4.83)	(1.34)	(1.14)	(4.47)	(1.28)	(1.13)
Large Savings Banks	1.02	1.85**	2.95**	.95	1.82*	2.84**
	(.90)	(.67)	(.75)	(.84)	(.71)	(.72)
Small Savings Banks	-1.98	.03	5.03	-1.61	-.05	5.01
	(2.87)	(1.02)	(3.27)	(2.59)	(1.02)	(3.44)
All Banks	2.10	1.87**	4.35**	2.15	2.00**	4.40**
	(2.19)	(.56)	(1.20)	(2.08)	(.54)	(1.17)

[1]The equations have been estimated with a White correction for heteroskedasticity and include the same set of explanatory variables as those in Tables 2 and 3. Standard errors in parentheses.
*Significant at 5% confidence level
**Significant at 1% confidence level

four bank subcategories (small savings banks being the exception), the capital/asset ratio has a significant effect on MMDA growth. On the other hand, for the NOW account equations, only that for large commercial banks shows a significant response. Thus the general pattern, whereby the more costly the account, the slower it grows when institutions become poorly capitalized, is confirmed. Our hypothesis that CDs may be distinguishable as the marginal source of funds for many institutions is also confirmed. In fact, a 1 percentage point decline in the capital/asset ratio implies a more than 4 percent decline in the growth rate of large CDs for the all-banks sample and a more than 7 percent decline in the large commercial banks sample.

Loans

The effects of capital constraints can be isolated better by examining deposits rather than loans. The data suggest a statistically significant positive relationship between a bank's capital/asset ratio and its deposit growth rate. To determine whether this capital crunch has resulted in a credit crunch, we must extend the analysis to assets.

Banks have several options available to reduce their assets. One possibility is selling securities, leaving their loan portfolio unchanged. If so, assets would shrink, but the size of their loan portfolio would be unaffected. Alternatively, they could shrink their loan portfolio either by selling or securitizing loans, by calling loans, or by tightening credit standards. Loan sales should be preferred by banks because they do not disrupt historical lending relationships. It has also become relatively easy to sell certain categories of loans. For example, an active secondary market exists for residential mortgages that conform to secondary market standards. It has also become common to sell consumer loans. These loan sales can reduce

the stock of loans in a bank's portfolio without affecting its flow of new lending. In that case, credit availability for new loans would be unaffected, despite a large decline in loans reported on a bank's balance sheet.

If banks choose to shrink by tightening credit standards and calling loans, borrowers will be affected only if alternative sources of credit are not available. Large firms with access to national credit markets will be insulated from many disruptions in bank lending. Similarly, firms in the middle market may have alternative sources of funds, such as foreign banks or banks inside or outside the region that are not capital constrained. In addition, insurance companies, venture capital firms, and finance companies have expanded operations to lend in markets traditionally serviced by banks. Therefore, even if banks in one region reduce their lending, credit availability becomes a problem only for those firms that must rely on local banks for their credit, either because they are too small to go outside the region or because banks outside the region and non-traditional lenders are not available.

Unfortunately, the data required to adequately address this question are not available. Loan sales are not reported in such a way that they can be attributed to loan categories. Furthermore, data are not broken down by size of firm, nor are data available on loans to firms in the region by insurance companies, finance companies, and pension funds. Using currently available sources, the link between a capital crunch and a credit crunch cannot be tested definitively.

Because of these serious empirical problems, we try only to identify whether the loan portfolio has shrunk as a result of the capital crunch. This can verify that the shrinkage is not entirely conducted with sales of

securities. However, it cannot determine whether new credit is less available than before.

Table 5 provides evidence concerning the effect of capital/asset ratios on total loan growth. A positive coefficient indicates that the lower a bank's capital/asset ratio, the slower its loan growth. If only securities were sold, no relationship between loan growth and bank capitalization should be present, even if banks were shrinking as a result of low capital/asset ratios. For the all-banks sample, the coefficient is positive and significant at the 1% confidence level. The estimated coefficients for commercial banks are larger and more significant than those for savings banks. Small savings banks is the only category with an estimated coefficient that is not statistically significant, though it is positive. The data thus support the hypothesis that institutions with lower capital/asset ratios have lower loan growth rates. This provides limited support for the hypothesis that the capital crunch in New England may be having an influence on lending behavior, though no definitive effect on credit availability can be determined from such tests.

IV. Conclusion

This paper finds evidence of a capital crunch in New England. Controlling for demand effects by using institutions experiencing the same macroeconomic and regional economic shocks, as well as by including bank characteristics that might be associated with different types of lending activities, we found a strong positive relationship between a bank's capital/asset ratio and the growth rate of its deposits. If banks were choosing to shrink, the shrinkage should be disproportionately in the more

Table 5
The Effect of Capital/Asset Ratios on Loan Growth by Category[1]
1990:1 - 1991:1

	K/A	Adjusted K/A
Large Commercial Banks	2.90**	3.08**
	(.69)	(.64)
Small Commercial Banks	1.32**	1.25**
	(.50)	(.48)
Large Savings Banks	1.01*	1.06*
	(.49)	(.46)
Small Savings Banks	.43	.39
	(.46)	(.43)
All Banks	1.09**	1.09**
	(.28)	(.26)

[1]The equations have been estimated with a White correction for heteroskedasticity and include the same set of explanatory variables as those in Tables 2 and 3. Standard errors in parentheses.
*Significant at 5% confidence level
**Significant at 1% confidence level

expensive (higher interest rate) accounts. We find that the growth rates of large CD accounts have responded significantly to capital/asset ratios, while core deposits generally showed a much smaller response.

Whether the capital crunch in New England has resulted in a credit crunch is still unresolved. Being a necessary condition, had we not found support for a capital crunch we could have ruled out a credit crunch, at least by this transmission mechanism. However, we do find strong support for a capital crunch in New England. We also find evidence that bank shrinkage has not been confined to securities, since more poorly capitalized institutions have had relatively slower loan growth rates. However, we cannot know whether new lending has declined or whether loan sales have increased. We also do not know whether other lenders (e.g., banks outside the region, insurance companies, or finance companies) have increased their lending activity sufficiently to fill the void left by low-capital banks. This link between a capital crunch and credit availability should be the subject of future research.

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