Bank Lending and the Transmission of Monetary Policy

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A resurgence of interest in the role of banks in the transmission of monetary policy has resulted in a spate of theoretical and empirical studies. These studies have established that, under certain conditions, the traditional transmission mechanism for monetary policy ("the money view") may be augmented through changes in the supply of bank loans ("the lending view"). Because both the money view and the lending view operate through the banking sector, the health of the banking system, insofar as it affects bank behavior, is an important factor in the transmission of monetary policy. It affects both the nature and the size of bank responses to shifts in monetary policy, with particular relevance for the bank lending channel.

The traditional description of monetary policy generally emphasizes the reserve requirement constraint on banks. In this story, banks are an important link in the transmission of monetary policy because changes in bank reserves influence the quantity of reservable deposits held by banks. Because banks rarely hold significant excess reserves, the reserve requirement constraint typically is considered to be binding at all times. However, a second constraint on banks, the capital constraint, may be more important in accounting for the variability in the magnitude of the effect of monetary policy over time. The extent to which a capital constraint is binding, unlike the reserve requirement, is likely to vary

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over time and across regions, since it depends on a variety of factors such as regulatory shocks, capital shocks, and business conditions.[1]

The capital constraint is likely to have its greatest effect on bank lending, and thus be particularly important for the lending channel of monetary policy. For example, a bank facing a binding capital-to-asset ratio will be unable to expand its assets in response to an easing of monetary policy, even if loan demand increases with the ease in policy, since it is a shortage of capital, not reserves, that is preventing the bank from increasing its lending. Thus, to the extent that a lending channel is important, it is likely to be short-circuited for banks facing a binding capital constraint that can insulate the banks' loan portfolios from reserve shocks.

We show that capital-constrained banks should respond to both monetary policy and bank capital shocks quite differently from unconstrained banks. In particular, when banks are capital-constrained, the lending channel is eliminated, because decreases in bank reserves that decrease transactions deposits are exactly offset by an increase in nontransactions deposits. Furthermore, our simple model predicts that loans by capital-constrained banks will rise in response to a tightening of monetary policy, with the liability side of the balance sheet unchanged and both reserves and securities declining. On the other hand, when banks are unconstrained, changes in nontransactions deposits do not exactly offset changes in transactions deposits, and loans should decrease in response to a tightening of monetary policy. We find some empirical evidence, consistent with the implications of the model, supporting the view that the effects of a lending channel and, more broadly, monetary policy, may vary over time as conditions in the banking sector change.

The first section of this paper describes the lending view and illustrates why New England banks may be a particularly fertile ground for examining the role of banks in the transmission of monetary policy. The second section provides a simple one-period model that illustrates why capital-constrained banks should not be expected to contribute to a separate lending channel. The model implies that a constrained bank should react differently to a monetary shock or a capital shock than would an unconstrained bank (or the constrained bank itself, when it was unconstrained). The third section provides an empirical test of the implications of the model and finds evidence of portfolio shifts by unconstrained banks that are consistent with the implications of a lending channel. This section also highlights the finding that empirical

[1] Romer and Romer (1993) have argued that monetary policy may have been less effective recently because tighter monetary policy was not combined with credit actions, as it frequently had been in the past. The explanation in this paper differs in that it emphasizes not the absence of credit actions, but rather the extent of binding capital constraints at banks, as distinguishing the early 1990s from earlier periods.

investigations of the impact of monetary policy that do not control for capital-constrained banks potentially can provide misleading results. The final section offers some conclusions and suggests some areas for further research.

Overview of the Lending Channel

Because a number of previous articles have highlighted the differences between the money channel and the lending channel (for example, Romer and Romer 1990; Kashyap and Stein 1994; Miron, Romer, and Weil 1994), we will provide only a brief overview. Following the overview, we will show that capital at New England banks followed a pattern during the most recent recession that differs both from the national pattern during that recession and from the New England pattern during prior recessions. Furthermore, perhaps as a consequence of the widespread capital shocks, New England banks have exhibited patterns in their asset and liability holdings that differ from those over previous business cycles. By exploiting these differences, we may be able to better understand how the health of the banking system may alter the effectiveness of monetary policy.

The sources of an independent lending channel can be understood best by considering a simple bank balance sheet (Figure 1A). Consider a bank whose only assets are reserves and securities, and whose only liabilities are (reservable) transactions deposits and capital. Open market operations that decrease reserves will cause interest rates to rise and induce individuals and firms to hold fewer transactions deposits until transactions deposits have declined sufficiently to bring required reserves back into line with available reserves, with banks holding fewer

Figure 1

Representative Bank Balance Sheets

A.	Assets	Liabilities
	Reserves Securities	Transactions Deposits Capital

B.	Assets	Liabilities
	Reserves Securities Loans	Transactions Deposits Nontransactions Deposits Capital

bonds and individuals holding more. Thus, the transmission mechanism operates solely through the user cost of capital, as interest rates rise to equate money demand and money supply. This is commonly called the traditional "money view."

An additional channel may arise with a more complicated financial intermediary, as shown in Figure 1B. This more complicated intermediary has three assets: reserves, securities, and loans. It also has three liabilities: (reservable) transactions deposits, (nonreservable) nontransactions deposits, and capital. In this case, an open market operation that decreases reserves potentially can have additional effects that operate through the asset side of the bank balance sheet. The decrease in reserves decreases transactions deposits, and this, if not offset by an increase in nontransactions deposits or a decrease in securities holdings, will result in a decrease in loans. Thus, a necessary condition for the lending channel to operate is that loans not be insulated from monetary policy changes by banks altering their nontransactions deposits and securities sufficiently to offset completely any change in their transactions deposits. It is this portfolio behavior that is the focus of this paper.

That monetary policy alters loan supply is a necessary but not a sufficient condition for the lending view. For the lending view to be operational, two other conditions must also be met. (See Kashyap and Stein (1994) for a detailed discussion of these requirements.) First, securities and bank loans must not be considered, by at least some firms, perfect substitutes as sources of funds. That is, some firms can be deemed to be bank-dependent for their credit needs, so that a change in the supply of bank loans has an impact on the real activities of firms. This proposition will be explored by other papers at this conference and has developed a significant academic literature in its own right (for example, Fazzari, Hubbard, and Petersen 1988; Gertler and Gilchrist 1994; Gertler and Hubbard 1988; Oliner and Rudebusch 1993). A second additional condition required for monetary policy to have real effects on the economy is that prices must be sticky, in order to prevent monetary policy from being neutral. This condition is critical for both the money and the lending views. While both of these additional conditions are critical for an operational lending channel, this paper will not consider them further but will explore only whether bank portfolio reactions to changes in monetary policy are consistent with the lending view.

Most empirical studies examining bank portfolio reactions to monetary policy have used vector autoregression techniques to examine the impact on lending of a change in monetary policy (for example, Bernanke and Blinder 1992). While such papers show that loans decline with a lag after a tightening of monetary policy, they cannot disentangle declines resulting from reduced loan demand from declines resulting from reduced loan supply. Kashyap and Stein (1995) attempt to overcome this problem in aggregate data by distinguishing between large and small banks. Based on capital market imperfections that affect the ability of banks to attract marginal sources of financing, their argument states that supply effects may occur disproportionately at small banks. Using micro banking data aggregated into different bank-size categories, they find evidence consistent with their hypothesis that the effects of monetary policy tightening are largest at small banks, which make primarily small business loans. However, if small business activity is disproportionately (relative to larger firms) affected by monetary policy tightening, this result still could reflect changes in loan demand rather than loan supply.

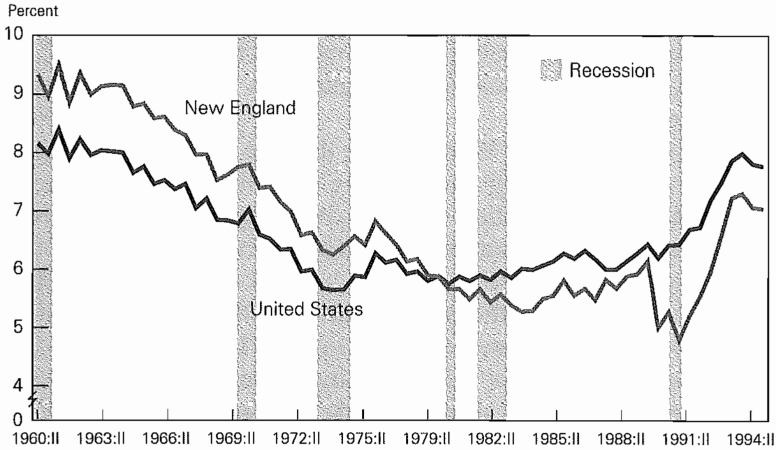
Kashyap and Stein (1995) recognize that the lending channel could be significantly reduced by banks being capital-constrained, but they find no evidence of this effect in their data. Figure 2, which presents capital-to-asset ratios for commercial banks in the United States and in New England from 1960:II to 1994:IV, shows why their results are unlikely to be affected by the capital crunch in the early 1990s. For the nation as a whole, capital ratios fell during the 1960s and 1970s, before gradually increasing in the 1980s and increasing more rapidly in the 1990s. However, capital ratios nationwide appear to be relatively insensitive to the business cycle; not only did they show no dramatic decline in the past recession, but they actually continued to increase.

While the general pattern of the New England bank capital ratio is similar to the national aggregate until the late 1980s, the two series differ sharply thereafter. Beginning in 1989, the capital ratio for New England banks declines dramatically, followed by a very steep increase in the 1990s. Thus, the capital crunch is likely to be reflected in data for New England, where capital-constrained banks represented a significant share of banks during the last recession, but not in aggregate national data, which are likely to be dominated by data for unconstrained banks. To the extent that the lending channel is severed for capital-constrained banks, differences between the portfolio reactions of constrained and unconstrained banks may best be tested using New England data.

This supposition is further supported by Figure 3, which shows the four-quarter change in real transactions deposits and nontransactions deposits (scaled by assets) at New England commercial banks. A necessary condition for the lending channel is that changes in nontransactions deposits not offset the changes in transactions deposits induced by changes in monetary policy. In fact, Romer and Romer (1990) have argued that the lending channel is unlikely to be supported because banks can offset changes in transactions deposits by substituting funds from alternative sources (in our model, nontransactions deposits) relatively costlessly. However, Figure 3 shows no clear pattern of offsetting changes in transactions and nontransactions deposits in

Figure 2

Ratio of Equity Capital to Total Assets at Commercial Banks in New England and the United States



Source: Board of Governors of the Federal Reserve System.

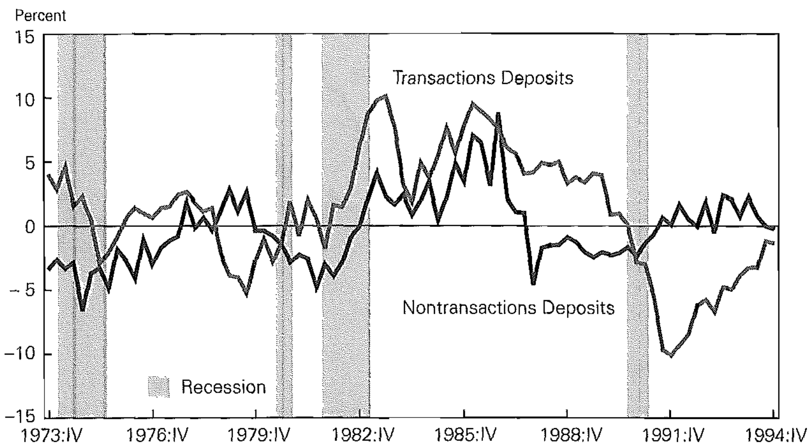
New England.[2] Furthermore, the figure shows that the behavior of bank deposits in New England was very different in the 1990s relative to earlier periods. In no previous recovery had nontransactions deposits exhibited a sustained decline at New England commercial banks. In the most recent episode, however, they showed a very substantial decline, one that more than offset the increase in transactions deposits as the federal funds target interest rate was reduced by the Federal Reserve in the early 1990s.

The recession in 1974 resulted in higher unemployment rates in New England than those of the 1990 recession, while the 1982 recession had a peak unemployment rate similar to that of the 1990 recession. However, the behavior of bank nontransactions deposits associated with the 1990 recession was quite different from that in either of the two

[2] The decline in nontransactions deposits in the late 1970s, the second largest shown in the figure, coincides with the introduction of NOW accounts in New England. Thus, it likely reflects the resulting substitutions out of nontransactions deposits and into NOW accounts, rather than being a consequence of a change in monetary policy.

Figure 3

FOUR-QUARTER CHANGE IN REAL TRANSACTIONS AND REAL NONTRANSACTIONS DEPOSITS (SCALED BY ASSETS) AT NEW ENGLAND COMMERCIAL BANKS

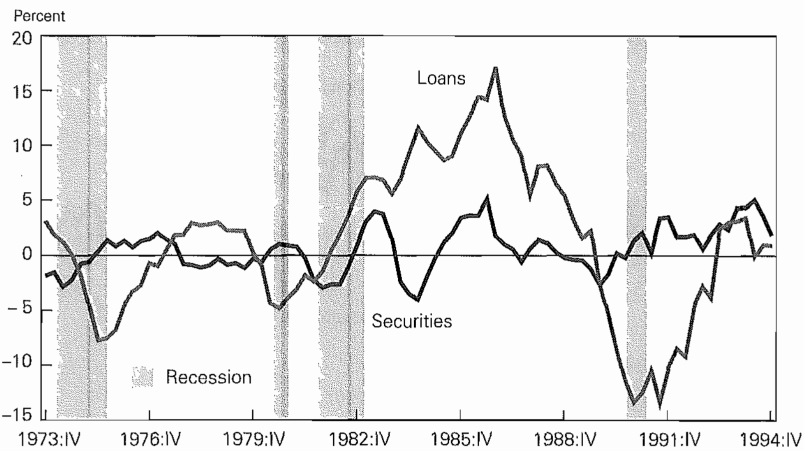


earlier recessions. As Figure 2 shows, this much more dramatic decline coincides with a large drop in bank capital, at a time when over 40 percent of bank assets in New England were held by banks under formal regulatory constraints (Peek and Rosengren 1995c). Changes in the proportions of constrained and unconstrained banks over time, in combination with the fact that constrained and unconstrained banks respond differently to changes in monetary policy, may help explain why this portfolio shift in bank deposits differed from earlier periods.

Recent movements in assets as well as liabilities at New England banks have differed from those in previous business cycles. Figure 4 shows the four-quarter change in real loans and securities (scaled by assets) at New England commercial banks. Bank loans in New England during the most recent cycle exhibited a much larger and more sustained decline that continued well after the bottom of the recession. Thus, while monetary ease appears to have stimulated lending in earlier recoveries, it failed to stem the significant declines in lending that continued through 1992 in New England. This evidence supports the view that bank lending may not respond to monetary ease at capital-constrained banks, but does react at banks that are unconstrained.

Figure 4

FOUR-QUARTER CHANGE IN REAL SECURITIES AND REAL LOANS (SCALED BY ASSETS) AT NEW ENGLAND COMMERCIAL BANKS



These figures also provide some evidence that bank portfolio behavior may differ between constrained and unconstrained banks and that New England may be a particularly fruitful place to look for these differences. The next section provides a theoretical model that examines why the strength of monetary policy is likely to be weakened when banks face binding capital constraints.

A SIMPLE MODEL OF BANK BEHAVIOR

To establish how the size of the effect of monetary policy is likely to be affected by capital-constrained banks, we provide a highly simplified one-period model of banks that is a variant of a model in Peek and Rosengren (1995a). The bank is assumed to have three assets, loans (L), securities (S), and reserves (R), and three categories of liabilities, bank capital (K), transactions deposits (DD), and nontransactions deposits (CD).

The balance sheet constraint requires that total assets must equal total liabilities.

$$R + S + L = K + DD + CD \tag{1}$$

On the liability side of the balance sheet, bank capital is assumed to be fixed in the short run. Transactions deposits are assumed to be inversely related to the federal funds rate (r_F). A general rise in market rates increases the opportunity cost of holding such deposits, causing bank customers to reduce their holdings of transactions deposits and shift into alternative assets paying market-related interest rates. Given that transactions accounts are tied to check-clearing services and convenience, this market tends to be imperfectly competitive. Banks set imperfectly competitive retail deposit interest rates (for example, NOW accounts) so as to maximize their monopoly rents from issuing these deposits. Thus, the quantity of imperfectly competitive transactions deposits can be treated as determined by profit-maximizing interest-rate setting, unrelated to the bank's overall need for funding.

$$DD = a_0 - a_1 r_F \tag{2}$$

Nontransactions accounts, on the other hand, serve as the marginal source of funds to the bank. We assume that a bank can expand total deposits by offering an interest rate on nontransactions deposits (r_D) greater than the mean rate in its market ($\overline{r_D}$). Offering a deposit rate greater than the mean deposit rate will draw funds not only from other banks inside and outside the banking region but also from financial instruments that are close substitutes, such as money market mutual funds and Treasury securities. The competitive nature of this market would suggest that the value of f_1, the sensitivity of nontransactions deposit inflows or outflows to changes in the bank's interest rate on such deposits, would be large.

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

On the asset side of the balance sheet, banks must hold reserves equal to their reserve requirement ratio (α) times their transactions deposits. We assume that banks hold no excess reserves. Securities are assumed to be a fixed proportion of transactions deposits (h) net of reserves. This is done in order to capture a buffer stock model for securities, whereby banks maintain securities for liquidity in the event of large withdrawals of transactions deposits.

$$R = \alpha DD \tag{4}$$

$$S = h_0 + h_1 DD - R \tag{5}$$

The bank loan market is assumed to be imperfectly competitive. A bank can increase (decrease) its loan volume by offering a loan rate (r_L) lower (higher) than the mean loan rate in its market ($\overline{r_L}$). Given the uniqueness of bank loans as a source of financing to many firms (see, for example, James 1987), the value of g_1, the sensitivity of loan demand to a change in the bank's loan interest rate, is likely to be large.

$$L = g_0 - g_1(r_L - \overline{r_L}) \tag{6}$$

The market interest rates on nontransactions deposits, loans, and securities are each assumed to be a function of market-specific effects and an effect related to the federal funds rate.

$$\overline{r_D} = b_0 + \phi r_F \tag{7}$$

$$\overline{r_L} = c_0 + \phi \mathrm{r_F} \tag{8}$$

$$\overline{r_s} = e_0 + \phi \mathrm{r_F} \tag{9}$$

To simplify the algebra, we assume that each market rate increases by the same amount (ϕ) for a given change in the federal funds rate.

Finally, bank behavior may be further constrained by the required capital-to-asset ratio (μ).[3]

$$K \geq \mu(R + S + L) = \mu(K + DD + CD) \tag{10}$$

Banks are assumed to maximize profits (π). Because our profit function abstracts from fee income and overhead costs, total profits are simply the sum of interest income on loans ($r_L L$) net of loan losses (ΘL) and interest received from securities holdings ($r_s S$), minus both interest paid on transactions deposits ($r_{DD} DD$) and interest paid on nontransactions deposits ($r_D CD$). Thus, profits are:

$$\pi = (r_L - \Theta)L + \overline{r_s} S - r_{DD} DD - r_D CD. \tag{11}$$

Using equations (1) to (9) to eliminate R, DD, L, S, r_D, r_L, and the three market interest rates from equations (10) and (11), the maximization problem can be stated as a Lagrangian equation, maximizing the profit function with the Lagrangian multiplier associated with the capital ratio constraint. The Lagrangian equation is maximized with respect to CD to obtain the first-order conditions.[4] Next, we use the first-order conditions to solve for CD in both the constrained and the uncon-

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[3] In this paper, we focus only on leverage ratio thresholds, for two reasons. First, risk-based capital ratios are not available before 1990. Second, for the period in New England under study here, leverage ratios rather than risk-based capital ratios tended to be the binding constraint on capital-constrained banks. This is consistent with evidence on nationwide samples that leverage ratios and not risk-based capital ratios affected bank behavior (for example, Hancock and Wilcox 1994).

[4] Of course, banks choose the level of CD by choosing r_D. However, because we are interested in quantities rather than interest rates, it is more direct to state the optimization problem in terms of choosing CD.

strained cases. This process can be repeated for the other variable of particular interest, loans. The testable hypotheses are then obtained by taking derivatives of the *CD* and the loan equations with respect to the federal funds rate and to bank capital.

It can easily be shown that when the capital constraint is binding, the following conditions will hold.

$$\frac{dCD}{dK} = \frac{1-\mu}{\mu} > 0 \tag{12}$$

$$\frac{dCD}{dr_F} = a_1 > 0 \tag{13}$$

$$\frac{d\ (total\ deposits)}{dr_F} = 0 \tag{14}$$

$$\frac{dL}{dr_F} = h_1 a_1 > 0 \tag{15}$$

$$\frac{dL}{dK} = \frac{1}{\mu} > 0 \tag{16}$$

When the capital constraint is binding, an increase in capital and an increase in the federal funds rate each increase nontransactions deposits. However, because a change in the federal funds rate causes offsetting changes in transactions and nontransactions deposits, total deposits are unchanged. One of the conditions of the lending view is violated: The contractionary (expansionary) effects of monetary policy on transactions deposits are completely offset by increases (decreases) in nontransactions deposits. Thus, the impact of a change in monetary policy will be much weaker when a substantial share of banks are capital constrained.

In fact, the binding constraint on bank capital causes loans to be positively related to the federal funds rate, as well as to bank capital. In this model, contractionary monetary policy actually increases bank loans. With the fall in reserves, transactions deposits fall, which in turn causes securities holdings to decline. With no change on the liability side of the bank balance sheet, the reduction in reserves and securities induces an increase in loans.

The unconstrained case generates results substantially different from those of the constrained case.

$$\frac{dCD}{dK} = \frac{-f_1}{f_1 + g_1} < 0 \tag{17}$$

$$\frac{dCD}{dr_F} = \frac{F_1 a_1(1 - h_1)}{f_1 + g_1} > 0, \textit{ assuming } h_1 < 1 \tag{18}$$

$$\frac{d(\textit{total deposits})}{dr_F} = \frac{-a_1(g_1 + f_1 h_1)}{f_1 + g_1} < 0 \tag{19}$$

$$\frac{dL}{dK} = \frac{g_1}{f_1 + g_1} > 0 \tag{20}$$

$$\frac{dL}{dr_F} = \frac{-g_1(1 - h_1)a_1}{f_1 + g_1} < 0, \textit{ assuming } h_1 < 1 \tag{21}$$

Nontransactions deposits increase with a decline in capital, in contrast to the decline that occurs in the constrained case, as banks substitute nontransactions deposits for some of their lost capital. Note that only the capital requirement matters for the reaction of nontransactions deposits to a capital shock in the constrained case, while only the interest sensitivities of both nontransactions deposits and loans (and not the required capital ratio) affect the reaction of nontransactions deposits to a capital shock in the unconstrained case.

For a monetary policy shock, these two interest sensitivities again play a key role in the unconstrained case, but are absent in the capital-constrained case. Nontransactions deposits increase with an increase in the federal funds rate as long as h_1 is less than 1. This is a reasonable assumption, given that only a proportion of deposits would be held in liquid form to cover possible withdrawals of transactions deposits. Note that while nontransactions deposits are positively related to federal funds changes in both the constrained and unconstrained cases, the effect is much smaller in the unconstrained case. Total deposits now decrease with an increase in the federal funds rate. Thus, unlike the constrained case, the effect of a monetary policy shock is only partially offset by a change in nontransactions deposits.

For loans, the results also differ. With a decrease in capital, loans decline, but less than one-for-one. In contrast, in the constrained case, the decline is the inverse of the capital requirement, which should be substantially greater than 1. With an increase in the federal funds rate, loans decline as long as h_1 is less than 1. Again, this is opposite to the result obtained in the constrained case. And, just as with the response of nontransactions deposits, the interest sensitivities of both nontransactions deposits and loans are important determinants of the magnitude of the response of loans to a change in the federal funds rate in the unconstrained case, but play no role when banks are capital-constrained.

Thus, this simple model yields several testable hypotheses concerning both the responsiveness of loans to changes in monetary policy and the possible pitfalls of failing to control for both capital shocks and monetary policy shocks:

1. Nontransactions deposits at constrained banks should respond more to a change in the federal funds rate than nontransactions deposits at unconstrained banks.
2. Total deposits at constrained banks should be unaffected by changes in the federal funds rate, while total deposits at unconstrained banks should be negatively related to changes in the federal funds rate.
3. Loans at constrained banks should respond positively to changes in the federal funds rate, while at unconstrained banks the response should be negative.
4. Loans at constrained banks should respond more to a capital shock than loans at unconstrained banks.
5. Nontransactions deposits at constrained banks should respond positively to a capital shock, while nontransactions deposits at unconstrained banks will respond negatively to a capital shock.

Additional implications could be derived if one were to assume that bank size is related to the sensitivity of deposits and loans to changes in a bank's interest rates. Kashyap and Stein (1994) argue that large and small banks face different market conditions in raising marginal sources of funding (nontransactions deposits). If so, f_1 will be positively related to the size of the bank. In the constrained case, neither the results for nontransactions deposits nor those for loans should be affected by differences in f_1. In the unconstrained case, however, nontransactions deposits at larger banks will be more responsive to changes in the federal funds rate compared to those at smaller banks, and loans at larger banks will be less responsive (see equations 18 and 21).

Along these same lines, another possibility is that loans at large banks, whose borrowers have greater access to national credit markets, have greater sensitivity to changes in loan rates than loans at smaller banks. This implies that g_1 will be larger for larger banks. This greater loan rate sensitivity has no impact on the responses to federal funds rate changes in the constrained case. However, in the unconstrained case, nontransactions deposits at larger banks will be less responsive to changes in the federal funds rate than those at smaller banks, and loans will be more responsive.

Larger values of f_1 and g_1 are each associated with larger banks, yet they have opposite effects on the magnitude of the response to changes in the federal funds rate of both transactions deposits and loans, making the net effect ambiguous. Thus, focusing on differing responses by large and small banks, as emphasized in Kashyap and Stein (1994), may not provide clear evidence unless one has priors on the magnitudes of the effects of bank size on the values of f_1 and g_1. While we have reason to believe both f_1 and g_1 are large, we have little evidence on their relative responses to changes in bank size. Thus, the clearest distinctions are likely to be between capital-constrained and unconstrained banks, rather than between large and small banks.

EMPIRICAL TESTS

The theoretical model, while highly simplified, indicates that constrained and unconstrained banks should respond quite differently to changes in monetary policy. Banks that are constrained would change loans in the same direction as movements in the federal funds rate, and banks that are unconstrained would change loans in the opposite direction. Thus, we will focus the empirical work on the determinants of the change in bank loans. The key implication is that the response of loans to a tightening (an easing) of monetary policy at unconstrained banks should be to decline (increase) more than at capital-constrained banks. Thus, as more banks become capital-constrained, we would expect the thrust of monetary policy passed from the banking sector to the rest of the economy to be weaker.

The Data

All bank balance sheet data are taken from the quarterly bank Call Reports. While some of the data series begin quarterly observations as early as 1972:IV, our regressions span only the 1976:II to 1994:IV period because of limitations on the availability of some variables and the need for lagged observations. We limit our sample to commercial banks, because savings banks reported only semiannually prior to 1984. We also use bank structure information to identify de novo banks and merger and acquisition activity, which will cause discontinuities in individual bank data unrelated to their lending behavior.

To empirically test the above hypotheses requires identifying capital-constrained and unconstrained banks. We base our categorization on the presence or absence of a formal regulatory action, supplemented with information on regulators' CAMEL ratings of banks. Formal actions (written agreements and cease and desist orders) are legally enforceable agreements between regulators and bank management and the board of directors. For financially troubled banks, these agreements specify target capital ratios, most commonly a 6 percent leverage ratio (Peek and Rosengren 1995e).

These are the most severe regulatory actions taken, short of closing the bank. And, because they are legally enforceable agreements with civil penalties for noncompliance, banks are likely to alter their behavior when a formal action is implemented. In fact, Peek and Rosengren (1995c) have documented that banks do reduce their lending as a result of the imposition of a formal regulatory action, and that the response occurs discretely at the time of the bank examination that results in the enforcement action. Furthermore, the imposition of formal regulatory actions was widespread in New England. At the peak in the early 1990s, the shares of both bank assets and bank loans in New England commercial and savings banks subject to formal actions exceeded 40 percent.

While formal actions will identify most capital-constrained banks, Peek and Rosengren (1995d) found that some banks do not receive formal actions because they are about to be closed or merged with another bank before the regulator can conclude the agreement. Because these institutions generally have very low capital, had they continued to operate as an independent entity they likely would have received a formal action. In these cases, the formal action information must be supplemented with supervisory ratings of banks. These ratings of the financial condition of the banks consider the capital adequacy, asset quality, management quality, earnings potential, and liquidity of the institution (CAMEL). The composite CAMEL rating, which can range from 1 to 5, provides an assessment by examiners of the strength of a banking institution. Banks with a composite rating of 4 (potential of failure, performance could impair viability) or 5 (high probability of failure, critically deficient performance), and some institutions with a CAMEL rating of 3 (remote probability of failure, flawed performance), normally will undergo an enforcement action. Thus, we define the set of constrained banks as those banks either under a formal action or having a CAMEL 4 or CAMEL 5 rating.

Banks with a composite rating of 1 (sound in every respect, flawless performance) and 2 (fundamentally sound, only minor correctable weaknesses in performance) are resistant to external economic and financial disturbances and are unlikely to be constrained by regulatory oversight. Thus, we define an unconstrained bank as any bank not under a formal action having a CAMEL rating of either 1 or 2. Because CAMEL 3 institutions not subject to formal actions are neither clearly constrained nor unconstrained, we do not include this set of banks in either of our two categories.

While a large share of New England banks were in our constrained category beginning in 1989, we were able to identify very few such banks during the period 1977 to 1988. First, information on formal actions is not publicly available prior to 1989. Second, through much of this period, fewer than five institutions in New England had a CAMEL rating of 4 or 5. Thus, the number of constrained institutions is not sufficient to form a constrained-bank aggregate prior to 1989, greatly limiting the length of time that can be used for comparisons. Until we can obtain the information required to expand the sample to include banks outside of New England, we can compare constrained and unconstrained institutions only from 1989:I through 1994:IV. However, because the large majority of banks in New England were relatively healthy during the earlier period, we can form an unconstrained bank sample from 1977:I through 1994:IV.

To form the constrained bank and unconstrained bank aggregate time series, we must address a number of problems, the most important being that banks may shift between categories over time. We use a standard technique to deal with this problem: We calculate the change in a variable for a given category one quarter at a time, using only data for the set of banks in that category in that quarter (see, for example, Gertler and Gilchrist 1994; Kashyap and Stein 1995). These quarterly changes are then linked together to form a time series.

Specifically, we use the following procedure. For each quarter, we first eliminate any bank that underwent structure changes in that quarter (for example, acquired another bank) or was in its first eight quarters of existence.[5] We then categorize as constrained any remaining bank that is under a formal action or has a CAMEL rating of 4 or 5 at the beginning of the quarter. To obtain a measure of the change in a variable, say loans, over the quarter, we sum the change in loans over the set of currently constrained banks to obtain the change in loans for constrained banks for that quarter and divide by the sum of beginning-of-period assets for the set of constrained banks. The quarterly time series is formed by repeating the calculation for each quarter in the sample. This will provide a consistent set of growth rates for each variable for each bank category, although the individual institutions in a category will change over time.

This procedure is repeated for the set of unconstrained banks, those banks that are not de novo banks, have not undergone structure changes in the quarter, are not under a formal regulatory action, and have a CAMEL rating of 1 or 2 at the beginning of the quarter.[6] We also construct data series for a total bank category, all banks that are not in their first eight quarters of existence and have not undergone structure changes during the quarter. This category includes not only our sets of constrained and unconstrained banks, but also banks not under a formal action with a CAMEL rating of 3.

Our proxy for changes in monetary policy is based on the targeted federal funds rate. The target federal funds rate series is taken from Rudebusch (1995) and extended after September 1992 using the Federal

[5] De novo banks show rapid growth and tend to have extremely high capital ratios. Since banks begin with all capital and no loans, and then quickly shrink capital and increase loans, their behavior during their initial quarters of existence is not representative of their behavior once they have matured. We thus omit the first eight quarters of operations of a new bank.

[6] Prior to 1982, there was no evidence of CAMEL 4 or 5 rated banks in New England. Because the number of banks with CAMEL ratings shrinks dramatically as we move to dates prior to the mid 1980s, in order to obtain a reasonable sample size we include all banks in our unconstrained category prior to 1982.

Reserve Bank of New York's internal "Report of Open Market Operations and Money Market Conditions."[7] The average of the federal funds rate target during the quarter, first differenced, is used as our proxy for changes in monetary policy. We include the contemporaneous value as well as two lagged values of this variable in the regressions.

Capital shocks are measured as the change in the equity capital of a bank category scaled by beginning-of-period assets. We include the contemporaneous value as well as two lagged values of this variable in the regressions. The regression equations also include the percentage change in New England employment over the previous year, two lags of the quarterly (CPI) inflation rate, and three quarterly seasonal dummy variables as explanatory variables.[8]

Empirical Results

Since the role of bank lending is at the core of the "lending view," we focus the empirical analysis on the change in bank loans.[9] Because of the limited length of the time series for constrained banks (23 quarters), the power of any test is likely to be weak. However, we are creating a national data base that will enable us to identify constrained institutions in earlier periods and to explore the disaggregated data at the level of the individual bank. Thus, the empirical work at this time is quite preliminary, but it does provide a crude test of the model presented in the earlier section.

Table 1 provides the results of comparing the effects of changes in monetary policy and capital shocks on loan growth from 1989:II to 1994:IV. The results are shown for the unconstrained, constrained, and total bank samples, with the results of both ordinary least squares (OLS) and two-stage least squares (2SLS) estimation techniques reported. We

[7] From October 1979 until January 1984, no explicit federal funds target is available because the Federal Reserve was formally setting a reserves target. Since any reserves target should imply a federal funds target, we use the average quarterly federal funds rate during the reserve targeting period.

[8] Because the short length of the time series for the constrained bank sample severely restricts our degrees of freedom, we limit our set of explanatory variables to contain at most only two lagged values. However, we did consider as many as four lagged values in regressions for the unconstrained bank sample estimated over the entire sample period, obtaining results that were qualitatively the same as those obtained when the set of explanatory variables was limited to two lagged values.

[9] Ideally, we would use a measure of new loans originated, that is, lending, rather than the change in loans outstanding in a bank's portfolio. The change in loans differs from lending because the loans on a bank balance sheet are affected by loan charge-offs, conversions of real estate loans to OREO, and net loan sales. Unfortunately, these data are not available for our sample period. However, in an earlier study that covered a shorter sample period when the data were available, we did make such adjustments (Peek and Rosengren 1995c), finding that the responses to formal actions were similar for the change in loans and measures of net new lending.

Table 1
The Effects of Monetary Policy and Capital Shocks on Loan Growth[a]
1989:II to 1994:IV

	Unconstrained Banks		Constrained Banks		Total Bank Sample	
Variable	OLS	2SLS	OLS	2SLS	OLS	2SLS
CFF	−.909	−1.341	−2.378	−2.380	−.803	−.917
	(.48)	(.68)	(1.44)	(1.44)	(.80)	(.89)
CFF(−1)	−.466	−.135	1.290	1.293	−.175	−.074
	(.28)	(.08)	(.91)	(.911)	(.21)	(.08)
CFF(−2)	.298	.084	3.272*	3.26*	2.922**	2.850**
	(.20)	(.05)	(2.37)	(2.36)	(3.80)	(3.63)
CEQ	2.009	1.054	1.181**	1.814**	3.222**	2.947**
	(.93)	(.45)	(3.38)	(3.18)	(3.77)	(2.92)
CEQ(−1)	−.216	−.253	3.471**	3.471**	−.133	−.162
	(.07)	(.09)	(4.67)	(4.67)	(.12)	(.14)
CEQ(−2)	.098	−.323	.427	.427	1.086	1.057
	(.02)	(.07)	(.61)	(.61)	(1.10)	(1.07)
ΣCFF	−1.077	−1.392	2.184	2.182	1.944	1.859
	(.51)	(.65)	(1.10)	(1.10)	(1.79)	(1.68)
ΣCEQ	1.891	.477	5.717**	5.712**	4.176*	3.84*
	(.31)	(.07)	(4.69)	(4.62)	(2.25)	(1.95)
$\bar{R}^2$	.0794	.0615	.799	.799	.818	.816
SER	.0163	.0164	.0166	.0166	.093	.093
DW	1.986	2.027	2.481	2.482	1.918	1.983

[a]Each regression also included a set of three seasonal dummy variables, two lagged values of the CPI inflation rate, and the percentage change in New England employment over the previous year. Absolute values of t-statistics in parentheses.

*Significant at the 5 percent confidence level.

**Significant at the 1 percent confidence level.

use two-stage least squares techniques to account for the possible endogeneity of the contemporaneous value of the change in bank equity capital. We use as instruments each of the other explanatory variables in the equation as well as an additional lagged value of the federal funds target interest rate, the change in equity capital, and the inflation rate, and two lagged values of both the change in other real estate owned and the change in loan loss reserves, each scaled by total assets. The OLS and 2SLS results are qualitatively similar.

The model implies that an increase in the federal funds target rate should have a negative effect on loans in the unconstrained bank sample and a positive effect for constrained banks. Or, if taken less literally, the relative implication of the model is that unconstrained banks should reduce loans by more than constrained banks in response to a tightening of monetary policy. Table 1 shows that the sum of the three coefficients on the change in the federal funds target rate (CFF, CFF(−1), and CFF(−2)) is negative for the unconstrained banks and positive for the constrained banks, although neither sum is significantly different from zero at the 5 percent confidence level. With respect to the individual coefficients, only the second lagged value of CFF in the constrained sample is significant. Still, these results highlight the differences in the estimated impact of monetary policy changes operating through constrained as compared to unconstrained banks, implying that the net impact of monetary policy at any given time may be quite sensitive to the health of the banking sector and the share of banks facing binding capital constraints.

For the total sample, the sum of the CFF coefficients is positive and significant only at the 10 percent confidence level, although the second lagged value is again highly significant. Thus, the results for the total sample appear to mimic those of the constrained, rather than the unconstrained, sample. If one were to base conclusions about the presence of an operational lending channel on this sample, the lending view would be rejected. Yet, it appears that the results from the total sample reflect only the fact that through much of this period, a significant proportion of loans were with capital-constrained banks.

The results for capital shocks are also consistent with the predictions of the model. The sum of the coefficients on the change in equity capital (CEQ) is positive in each case, and much larger (and significant at the 1 percent confidence level) for the constrained bank sample. Again, the total sample results mimic those for the constrained sample.

The adjusted R^2 is much higher for the constrained sample than for the unconstrained sample. The much better fit is not surprising, given the earlier equations. For constrained banks, little other than capital ratios and the interest sensitivity of transactions accounts determines loan growth, while at unconstrained banks, idiosyncratic characteristics such as the conditions in the local lending and deposit markets (as reflected, for example, in the values of f_1 and g_1 for a particular bank) may be much more important.

One should keep in mind that with only 23 quarters of data, the power of the statistical test is low. Nonetheless, the results are broadly consistent with the simple model from the previous section. Moreover, the evidence highlights the fact that ignoring the differing responses of constrained and unconstrained banks potentially can affect the size of the impact of monetary policy on the economy and the ability to find evidence of an operational lending channel in aggregate data.

Table 2 shows the effects of monetary policy and capital shocks on loan growth for the unconstrained bank sample for the entire 1976:II to 1994:IV period. For this specification, we have omitted the 1980:II-1981:II observations to avoid the effects of the Carter credit controls on

Table 2
The Effects of Monetary Policy and Capital Shocks on Loan Growth:[a]
Unconstrained Bank Sample
1976:II to 1994:IV

Variable	OLS	2SLS
CFF	−.684**	−.893**
	(2.82)	(2.90)
CFF(−1)	−.196	−.084
	(.77)	(.28)
CFF(−2)	−.558*	−.733*
	(2.02)	(2.18)
CEQ	4.817**	−2.134
	(3.45)	(.44)
CEQ(−1)	.922	2.891
	(.48)	(1.17)
CEQ(−2)	−1.506	−.624
	(.67)	(.22)
ΣCFF	−1.438**	−1.615**
	(3.50)	(3.32)
ΣCEQ	4.233	1.315
	(1.476)	(.33)
$\bar{R}^2$	.594	.477
SER	.015	.017
DW	.914	1.046

[a] Each regression also included a set of three seasonal dummy variables, two lagged values of the CPI inflation rate, and the percentage change in New England employment over the previous year. Absolute values of t-statistics in parentheses.

* Significant at the 5 percent confidence level.

** Significant at the 1 percent confidence level.

contemporaneous and lagged data, the 1984:I observation because of discontinuities in the call report data, and the 1986:IV and 1987:I observations because of the effects on the timing of investment and loans associated with the Tax Reform Act of 1986.

For the entire unconstrained bank sample, the sum of the coefficients on the federal funds target rate is negative and statistically significant at the 1 percent confidence level. Furthermore, the coefficient sums for both the OLS and 2SLS specifications are in the same range as those for the 1989:II to 1994:IV sample in Table 1, being only slightly larger in absolute value. The sums of the coefficients on the change in capital are positive, but not significantly different from zero.

The Durbin-Watson statistics are low, indicating that the equations for the full sample may be misspecified. However, when the equations are reestimated allowing the coefficients on CFF and CEQ during the period after 1989:I to differ from those in the earlier period, no evidence is found of serial correlation in the error term. A Chow test splitting the sample at 1989:I produces an F-statistic of 2.82, significant at the 1 percent confidence level. However, it appears that it is the difference between the CEQ coefficients across the two subperiods rather than those for CFF that accounts for the low Durbin-Watson statistics. The F-statistic for the test of CFF coefficient equality across the two subperiods is only 0.79, while that for CEQ is 11.05, significant at the 1 percent confidence level. This suggests problems in treating the predominantly positive capital shocks during the earlier subperiod in the same way as the predominantly negative capital shocks that occurred during the later subperiod, even at banks that were not capital-constrained.

CONCLUSION

This paper highlights the importance of considering regulatory factors when investigating the size and nature of the impact of monetary policy on the economy. Since monetary policy operates through the banking sector, one must take into consideration the effects of regulatory policy on the banking sector, as well as the sector's general health, to be able to predict bank responses to a change in monetary policy. In particular, one must recognize that banks may face not only a binding reserve requirement but also a binding capital requirement. In a simple one-period model, we show that capital-constrained and unconstrained banks are likely to react differently to both monetary policy and capital shocks. By constructing time series data for constrained and unconstrained bank samples in New England, we find some evidence consistent with the implications of our model.

While the econometrics are preliminary and the power of the tests is restricted by the absence of a constrained bank sample prior to 1989, we find evidence that monetary policy effects operating through unconstrained banks should be expected to have a stronger effect on the economy compared to the effects transmitted through capital-constrained banks. This suggests that the large number of capital-constrained banks in New England in the early 1990s may have played an important role in the slow recovery of this region from the 1990 recession. We also find evidence that unconstrained banks behaved in a manner consistent with an operational lending channel. Furthermore, we find that evidence from aggregate data for all banks for the most recent period yields results consistent with the constrained bank sample, making one more likely to reject the hypothesis of an operational lending channel.

To fully test the importance of capital constraints on the impact of monetary policy, we need to expand our sample nationwide to cover a longer time period containing a sufficient number of constrained banks to make the constrained-unconstrained bank comparison sharper. We are currently constructing a national panel data set that will examine differences in bank behavior over business cycles and regulatory regimes. However, this initial work does support the contention that the transmission of monetary policy must be considered in the context of regulatory as well as monetary policy shocks.

References

Bernanke, Ben S. and Alan S. Blinder 1988. "Credit, Money, and Aggregate Demand." *The American Economic Review, AEA Papers and Proceedings*, vol. 78, pp. 435–39.

———. 1992. "The Federal Funds Rate and the Channels of Monetary Transmission." *The American Economic Review*, vol. 82, pp. 901–21.

Bernanke, Ben S. and Cara S. Lown. 1991. "The Credit Crunch." *Brookings Papers on Economic Activity*, No. 2, pp. 205–39.

Fazzari, Steven M., R. Glenn Hubbard, and Bruce Petersen. 1988. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity*, No. 1, pp. 141–95.

Gertler, Mark and Simon Gilchrist. 1994. "Monetary Policy, Business Cycles and the Behavior of Small Manufacturing Firms." *Quarterly Journal of Economics*, vol. 109, Issue 2, May, pp. 309–40.

Gertler, Mark and R. Glenn Hubbard. 1988. "Financial Factors in Business Fluctuations." In *Financial Market Volatility: Causes, Consequences, and Policy Recommendations*, pp. 33–71. Federal Reserve Bank of Kansas City.

Hancock, Diana and James A. Wilcox. 1994. "Bank Capital and the Credit Crunch: The Roles of Risk-Weighted and Unweighted Capital Regulations." *Journal of the American Real Estate and Urban Economics Association*, vol. 22, Spring, pp. 59–94.

James, Christopher. 1987. "Some Evidence on the Uniqueness of Bank Loans." *Journal of Financial Economics*, vol. 19, pp. 217–35.

Kashyap, Anil K. and Jeremy C. Stein. 1994. "Monetary Policy and Bank Lending." In *Monetary Policy*, edited by N. Gregory Mankiw, pp. 221–56. Chicago, IL: University of Chicago Press.

———. 1995. "The Impact of Monetary Policy on Bank Balance Sheets." *Carnegie-Rochester Conference Series on Public Policy*, vol. 42, June, pp. 151–95.

Kashyap, Anil K., Jeremy C. Stein and David W. Wilcox. 1993. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance." *The American Economic Review*, vol. 83, March, pp. 78–98.

Miron, Jeff, Christina Romer, and David Weil. 1994. "Historical Perspectives on the Monetary Transmission Mechanism." In *Monetary Policy*, edited by N. Gregory Mankiw, pp. 263–306. Chicago, IL: University of Chicago Press.

Oliner, Stephen and Glenn Rudebusch. 1993. "Is There a Bank Credit Channel for Monetary Policy?" Working Paper, Federal Reserve Board, Washington, D.C.

Peek, Joe and Eric S. Rosengren. 1995a. "The Capital Crunch: Neither a Borrower Nor a Lender Be." *Journal of Money, Credit and Banking*, vol. 27, no. 3 (August), pp. 625–38.

———. 1995b. "Bank Regulation and the Credit Crunch." *Journal of Banking and Finance*, vol. 19, no. 1 (June), pp. 679–92.

———. 1995c. "Banks and the Availability of Small Business Loans." Federal Reserve Bank of Boston Working Paper 95–1, January.

———. 1995d. "Prompt Corrective Action Legislation: Does It Make a Difference?" Unpublished manuscript, May.

———. 1995e. "Bank Regulatory Agreements in New England." *New England Economic Review*, May/June, pp. 15–24.

Romer, Christina D. and David H. Romer. 1990. "New Evidence on the Monetary Transmission Mechanism." *Brookings Papers on Economic Activity*, No. 1, pp. 149–213.

———. 1993. "Credit Channel or Credit Actions? An Interpretation of the Postwar Transmission Mechanism." In *Changing Capital Markets: Implications for Monetary Policy*, Federal Reserve Bank of Kansas City, pp. 71–116.

Rudebusch, Glenn. 1995. "Federal Reserve Interest Rate Targeting, Rational Expectations, and the Term Structure." *Journal of Monetary Economics*, vol. 35, April, pp. 245–74.

DISCUSSION

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The interesting paper by Joe Peek and Eric S. Rosengren is a contribution to the debate over the so-called "lending view" of the monetary transmission mechanism. As I elaborate below, the lending view channel for monetary policy requires that some group of borrowers be "bank-dependent" and that the central bank be able to affect the supply of bank loans through monetary policy. The essential idea put forth by the authors is that comparing loan responses of "capital-constrained" and "capital-unconstrained" banks to changes in monetary policy offers a way to test the second requirement of the lending view.[1]

Following the Peek and Rosengren paper, my remarks are organized around five questions: Is an effect of monetary policy on bank loan supply necessary or sufficient to corroborate the importance of capital-market imperfections in spending decisions? Second, does the authors' model of bank behavior illustrate the lending view? Third, why study lending in the New England region? Fourth, are the empirical tests convincing? Finally, where do we go from here?

PUTTING THE LENDING VIEW IN CONTEXT

Let me begin by characterizing the traditional "money view" of the monetary transmission mechanism.[2] In this view, financial intermedi-

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[1] The other requirement is not addressed in the paper (but see the paper by Himmelberg and Morgan in this volume).

[2] More detailed descriptions of alternative monetary transmission mechanisms can be found in Bernanke and Gertler (1995) and Hubbard (1995b).

aries ("banks") offer no special services on the asset side of their balance sheet. On the liability side of their balance sheet, banks perform a special role; the banking system creates money by issuing demand deposits. Underlying assumptions about borrowers is the idea that capital structures do not influence real decisions. To keep the story simple, suppose that there are two assets—"money" and "bonds." In a monetary contraction, the central bank reduces reserves, limiting the banking system's ability to sell deposits. Depositors must then hold more bonds and less money in their portfolios. If prices do not instantaneously adjust to changes in the money supply, the fall in household money holdings represents a decline in real money balances. To restore equilibrium, the real interest rate on bonds increases, raising the user cost of capital for a range of planned investment activities, and interest-sensitive spending falls.

The search for a richer transmission mechanism reflects two concerns. The "macro" concern is that cyclical movements in aggregate demand appear too large to be explained by monetary policy actions, which have not generally led to large, prolonged changes in real interest rates. This has pushed some macroeconomists to identify financial factors in propagating relatively small shocks, factors that correspond to "accelerator" models that explain investment data relatively well.

The "micro" concern relates to the growing literature studying information imperfections in insurance and credit markets. In this line of inquiry, problems of asymmetric information between borrowers and lenders lead to a gap between the costs of external finance and internal finance. The notion of costly external finance stands in contrast to the more complete markets approach underlying the conventional interest-rate channel, which does not consider links between real and financial decisions.

While a review of this literature is beyond the scope of these remarks, let me mention three common empirical implications. The first is that uncollateralized external finance is more expensive than internal finance. Second, the spread between the costs of external and internal finance varies inversely with the borrower's net worth—internal funds and collateralizable resources—relative to the amount of funds required. Third, an adverse shock to a borrower's net worth increases the cost of external finance and decreases the ability of the borrower to implement investment, employment, and production plans. This channel provides a "financial accelerator" magnifying an initial shock to net worth.

One can extend this argument to include a channel for monetary policy. In the money view, policy actions affect the overall level of interest rates and interest-sensitive spending. The crux of models of information-related financial frictions is a gap between the costs of external and internal finance for many borrowers. It is possible for monetary policy (open market operations or regulatory actions) to affect this gap. Two such channels have been identified: financial constraints on borrowers (a "balance sheet" channel), and the existence of "bank-dependent" borrowers (the "lending" channel). A significant body of empirical research supports the former channel (see the review in Hubbard 1995a). The latter channel is the one related to the Peek-Rosengren analysis. Specifically, Peek and Rosengren focus on a necessary precondition for the lending channel, namely, that the central bank can affect the supply of bank loans.

Two significant concerns have been raised about the precondition that central bank actions can affect loan supply. The first is the difficulty in identifying exogenous changes in banks' ability to lend. The second is the need to explain why it is costly to substitute nontransactions deposits or new equity for transaction deposits in order to fund loans. I discuss these concerns below in the context of the authors' model.

Model of Bank Behavior

The model of bank decisions presented extends earlier work by the authors. The basic idea is to use balance sheet relationships at a point in time to examine comparative statics (the response of bank loans to changes in the target federal funds rate or to changes in equity capital). Peek and Rosengren stress three predictions. First, capital shocks generate (directionally) different effects on CD borrowing for "constrained" and "unconstrained" banks. Second, policy shocks (changes in the funds rate target) generate (directionally) different effects on loan supply for constrained and unconstrained banks. Third, total deposits in constrained banks do not change in response to a change in the funds rate target, while total deposits in unconstrained banks fall in response to an increase in the funds rate target. The authors argue that capital constraints are a more useful way to group banks than bank size, because the values of model parameters that govern the response of loans to changes in the funds rate target and changes in equity capital likely vary across bank size groups.

The authors need the model really only to establish that an effect of monetary contraction on loan supply is greater for banks with no binding capital constraint than for banks facing a binding capital constraint. This point can be illustrated somewhat more simply and in a way that avoids counterintuitive implications—for example, that loans by constrained banks rise in response to a monetary tightening.[3]

[3] It is the difference in the effects that is important for the subsequent empirical work. The prediction of the model that loans by capital-constrained banks will rise in response to a monetary tightening is an artifact of the assumed form of the securities demand relationship.

To see this, let me reformulate the model articulated by Peek and Rosengren; variable definitions match those in their paper. In the example below, I make two assumptions different from those in the Peek and Rosengren paper: The interest rate on demand deposits is zero, and the loan market is competitive. Banks maximize profits subject to a reserve requirement, liquidity constraint, balance sheet identity, and capital adequacy constraint:[4]

$$\max\ [(r_L L - \theta)L + r_s S - r_D CD] \qquad \text{(Profit maximization)}$$

subject to:

$$R \geq \alpha\, DD \qquad \text{(Reserve requirement)}$$

$$R + S \geq h_0 + h_1\, DD \qquad \text{(Liquidity constraint)}$$

$$R + L + S = CD + DD + K \qquad \text{(Balance sheet identity)}$$

$$K \geq \mu L \qquad \text{(Capital adequacy constraint)}^5$$

If all constraints bind except the capital constraint, $r_L = \theta + r_D + (r_D')CD$, where $r_D' = (1/f_1)$ in their model. If $r_D' = 0$ ($f_1 \rightarrow \infty$), then the loan rate equals the CD rate; absent increasing marginal costs of CD financing, no scope remains for the lending view. When $r_D' > 0$, banks face a rising marginal cost of CD finance. In the short run, if $(r_L - r_D)$ does not change, the volume of CD borrowing is pinned down; a decrease in reserves of \$1 reduces deposits by $(1/\alpha)$, loans by $(1 - h_1)/\alpha$, and securities by $(h_1/\alpha - 1)$. In equilibrium, the loan-CD spread may change, depending in part on the size of r_D' (or f_1). The bottom line is that when loans and CDs are imperfect substitutes, both $(r_L - r_D)$ and loan supply will be affected by shocks to reserves.

The capital constraint may bind if raising additional equity is costly under asymmetric information. In this case, the liquidity constraint will not bind, because banks hold more securities than required for liquidity (capital constrains the volume of loans). With loans tied down by the capital constraint, changes in the bank's portfolio in response to a change in reserves occur through changes in securities holdings.

While some caution in interpretation is in order (for example, because these exercises ignore dynamics and the possibility of expected future constraints), such simple models illustrate the potential usefulness of capital constraints for tests of whether monetary policy affects bank loan supply.

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[4] As do Peek and Rosengren, I abstract from the more complicated structure of capital and leverage requirements in practice.

[5] This assumes a zero capital requirement on securities.

WHY NEW ENGLAND?[6]

Peek and Rosengren note that Kashyap and Stein (1995) fail to find much of an effect from capital constraints on the lending channel in their analysis of data for the nation as a whole. While capital-asset ratios rose over the late 1980s and 1990s (and through the 1990–91 recession) for the nation as a whole, they fell in New England over the period from 1989 through mid 1991, increasing sharply thereafter. Hence, the New England region may offer a better laboratory for studying the interaction of capital constraints and the lending channel.

While the intuition behind this regional focus is clear, I have a concern: The period of falling bank capital-asset ratios corresponds to a period in which the net worth of many New England borrowers (especially in real estate) is falling, so that it is difficult to isolate a causal link between changes in bank capital and bank lending. I return to this point later.

EMPIRICAL TESTS AND RESULTS

The authors' tests use quarterly Call Report data for New England banks. To measure "capital constraints," they use the presence or absence of a formal regulatory action, supplemented by information on supervisory CAMEL ratings (for example, for institutions about to be closed or merged with other banks). Before discussing the results, two pitfalls in using the data should be acknowledged (as they are by the authors): the shortness of the time period for the constrained bank sample (1989 to 1994), and the use as a control group of an unconstrained bank sample including data from an earlier period (1977 to 1994). With respect to the latter point, a better idea would be to use a control group drawn from other regions in the United States.

The paper's empirical results are presented in its Tables 1 and 2. The results reported in Table 1 examine the response of loans in the constrained and unconstrained subsamples to changes in the federal funds rate target and changes in equity. Loans by unconstrained banks respond more to changes in the federal funds rate target than those by constrained banks, though the differences are not statistically significant. Equity changes have a larger positive effect on loans for the constrained subgroup.

Peek and Rosengren suggest that findings in Table 1 do not support the lending view, but I have two concerns. First, the fact that "total sample" patterns follow "constrained sample" patterns might simply

[6] I am, of course, discounting the explanation that the research program is supported by the Federal Reserve Bank of Boston.

indicate that more loans were made by (large) capital-constrained banks. Second, the test is not really one of the "lending view" but of the relationship between changes in the funds rate and bank lending. More convincing differences between the two groups are observed for changes in equity capital. That capital shocks affect lending by constrained banks is certainly reasonable but, again, this is not a test of the lending view per se.

Table 2 reports results for the longer-period sample of unconstrained banks. In these tests, the change in the federal funds rate target has a negative and statistically significant effect on loans; changes in capital have an insignificant effect on loans. Even this evidence is somewhat difficult to interpret. Large standard errors make it difficult to use the results as a benchmark to compare against Table 1. Again, a comparison of results from different regions might be more fruitful.

The paper concludes noting "evidence that unconstrained banks behaved in a manner consistent with the lending channel." Perhaps. On a narrow level, the standard errors are really too large to make convincing the claim that an increase in the federal funds rate target reduces bank loan supply. On a broad level, neither for Table 1 nor for Table 2 can one be sure that the authors are estimating *loan supply* rather than *loan demand*. Nonetheless, the evidence suggests potentially promising future research with the national panel data set.

WHERE DO WE GO FROM HERE?

Because the "lending view" involves assumptions about capital-market imperfections for both banks and borrowers, more complete tests of the lending view require analysis of banks and borrowers jointly. In an ideal world, data matching borrower, loan, and lender characteristics could be used to sort out "lending view" and "balance sheet view" channels. Short of that, research could focus on two questions. First, are small or low-net-worth borrowers more likely to be the customers of constrained banks? Second, do low-net-worth firms have limited opportunities to substitute credit from unconstrained financial institutions when cut off by constrained financial institutions? Researchers have begun considering these questions,[7] and I suspect we will have much more micro evidence about the validity of the lending view in the near future.

[7] See, for example, Calomiris, Himmelberg, and Wachtel (1995) and Himmelberg and Morgan (1995).

References

Bernanke, Ben S. and Mark Gertler. 1995. "Inside the Black Box: The Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives*, vol. 9, pp. 27–48.

Calomiris, Charles W., Charles P. Himmelberg, and Paul Wachtel. 1995. "Commercial Paper, Corporate Finance, and the Business Cycle: A Microeconomic Perspective." *Carnegie-Rochester Conference Series on Public Policy*, vol. 42, pp. 203–50.

Himmelberg, Charles P. and Donald Morgan. 1995. "Is Bank Lending Special?" This volume.

Hubbard, R. Glenn. 1995a. "Capital Market Imperfections and Investment." Mimeograph, Columbia University, June. *Journal of Economic Literature*, forthcoming.

———. 1995b. "Is There A 'Credit Channel' for Monetary Policy?" Federal Reserve Bank of St. Louis *Review*, May/June, pp. 63–77.

Kashyap, Anil K. and Jeremy C. Stein. 1995. "The Impact of Monetary Policy on Bank Balance Sheets." *Carnegie-Rochester Conference Series on Public Policy*, vol. 42, June, pp. 151–95.

Discussion

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The paper by Joe Peek and Eric S. Rosengren addresses an important and timely issue: Do binding bank capital requirements affect the way monetary policy is transmitted? Using a simple model of the banking firm, the authors show that capital-constrained banks will respond to monetary policy shocks differently than unconstrained banks. Specifically, they show that the so-called "lending channel" for monetary policy is more important for banks that are unconstrained by capital requirements than for banks subject to binding capital requirements. Using a sample of New England banks, the authors provide preliminary empirical evidence consistent with the predictions of their model.

The major contribution of the paper, in my opinion, is its demonstration that the regulatory environment in which banks operate can have an important influence on the way monetary policy is transmitted to the real economy. However, just how capital requirements affect the relationship between loan growth and monetary policy is, I believe, more complicated than the predictions of the authors' simple model suggest. Specifically, the authors' conclusion, that the lending channel does not operate when banks are capital constrained, is the result of several assumptions that are likely to be violated in the real world. My comments will focus on the implications of relaxing these assumptions.

Background

For a lending channel for monetary policy to operate, several conditions must be met. First, banks must view reservable transaction ac-

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counts and nontransaction accounts as not perfect substitutes for one another. In Peek and Rosengren's model (as in similar work by Kashyap and Stein 1995), this is accomplished through assuming that the volume of transaction deposits for individual banks is determined by monetary policy (and is not a decision variable for individual banks). In contrast, the amount of CDs and other nontransaction deposits is assumed to be determined by the interest rate an individual bank pays.

A second condition for a lending channel is that loans and securities be imperfect substitutes in bank portfolios. In the lending channel literature, securities are assumed to be held as a precaution against deposit outflows. Loans, on the other hand, are assumed to be illiquid and acquired in less than perfectly competitive markets. Peek and Rosengren employ a similar set of assumptions in their model, except that they assume that securities are held as a fixed proportion of demand deposits. As I will discuss in a moment, this assumption is peculiar given that, with leverage-based capital requirements, securities are also held as a precaution against capital shocks.

If these first two conditions are met, it is straightforward to show that monetary policy will affect loan supply. For example, consider a decrease in reserves that causes a decline in demand deposits. So long as the decline in demand deposits is not completely offset by a decline in securities holdings, the bank must rely more on costly external debt (CDs and other nontransaction accounts). This increase in bank funding costs in turn results in a decline in the supply of loans. To complete the story, the decrease in the supply of bank loans will affect aggregate investment and output, if firms view bank loans and other forms of external financing as imperfect substitutes for one another.

How Have Regulatory Changes Affected the Lending Channel?

Assuming the conditions for a lending channel are met, how have regulatory changes over the past decade affected its operation? Two bank regulation changes appear to be particularly important (but working, perhaps, at cross-purposes). First, beginning in the late 1980s, implicit deposit guarantees on large uninsured bank liabilities were significantly curtailed. Specifically, the passage of FDICIA in 1991 signaled the formal abandonment (in theory) of the extension of implicit deposit insurance to large deposits and nondeposit liabilities of commercial banks. Since it is reasonable to assume that implicit insurance had a greater effect on the cost of CDs and other potentially information-sensitive deposits than on the cost of transaction accounts, the curtailment of deposit insurance should reduce the degree of substitutability between demand deposits and other sources of deposit financing. The reduction in the degree of substitutability in turn works to increase the sensitivity of loan supply to changes in monetary policy, thereby strengthening the importance of the lending channel.

The second set of regulatory changes affecting the lending channel were changes in capital requirements. Specifically, risk-based capital requirements were implemented, the required level of capital was raised, and enforcement became more stringent, beginning in 1990. The implications of these changes are the primary focus of the authors' paper. While I agree with the paper's conclusion that binding capital requirements serve to decrease the sensitivity of loan supply to monetary policy, the authors' conclusion that capital-constrained banks respond to monetary policy in a qualitatively different way than unconstrained banks is, I believe a special case. In particular, this result holds only when risk-based capital requirements are binding.

Capital requirements affect the lending channel through their effect on the substitutability of loans for securities in a bank's portfolio. One of the least well understood parts of bank portfolio management, I believe, is why banks hold government securities. Models of lending channels (including the present model) generally assume that banks hold securities as a precaution against deposit withdrawals. In these models, securities are a substitute for external debt financing. The greater the cost of external debt financing and the greater the volatility in the supply of demand deposits, the greater the demand for securities as an inventory of liquidity.

With capital requirements based on overall leverage, there is a second reason to hold securities: as a buffer against capital shocks. In particular, with capital requirements based on total assets, banks can respond to a capital shock by selling securities and shrinking their asset base. The demand for securities should therefore depend on the volatility of bank earnings or capital as well as the cost associated with a binding capital requirement. In summary, one advantage of holding securities when operating under leverage-based requirements is that securities reduce the dependence of loan growth on internally generated capital.

In contrast, with binding risk-based capital standards, securities can no longer buffer loan growth from capital shocks. Specifically, since government securities have a zero risk weight, liquidating securities does not free up capital to fund loans. While the authors focus on the effects of binding leverage requirements, their assumption that securities holdings are a fixed proportion of transaction deposits effectively means that "risk-weighted" capital requirements are binding. In a more general model, such as Kashyap and Stein's (1995), the lending channel of monetary policy continues to operate even though leverage-based capital requirements are binding.[1]

To summarize, the effect of capital requirements on the transmission of monetary policy depends on whether the risk-weighted capital requirement is binding or not. The greater emphasis on risk-weighted capital requirements since the 1989–90 period is likely to reduce the importance of the lending channel for capital-constrained banks. I think this explains the authors' preliminary results concerning the absence of a lending channel among capital-constrained banks beginning in 1989. The introduction of risk-based capital requirements may also explain the structural shift the authors find for unconstrained banks beginning in 1989 (see their Table 2).

Let me conclude by suggesting a way of empirically determining the importance of risk-related capital requirements and, indirectly, the operation of the lending channel of monetary policy. As I mentioned earlier, a necessary condition for a lending channel is that external financing is costly relative to internally generated funds and demand deposits. As a result, one would expect bank loan growth to be sensitive to the amount of internally generated funds. I would also expect loan growth at capital-deficient banks to be more sensitive to internally generated additions to capital. Moreover, whether a bank's security holdings affect the sensitivity of loan growth to internally generated funds will depend on whether the leverage requirement or the risk-based capital requirement is binding. If the leverage requirement is binding, then I would expect the sensitivity of loan growth to internally generated funds to vary inversely with a bank's holdings of securities. On the other hand, finding no relation between securities holdings and the sensitivity of loan growth to internally generated funds would be evidence that the risk-based capital standard is binding. A finding that risk-based requirements are binding would also suggest that the lending channel is relatively unimportant (since bank loan growth is restricted by the amount of equity capital).

Reference

Kashyap, Anil K. and Jeremy C. Stein. 1995. "The Impact of Monetary Policy on Bank Balance Sheets." *Carnegie-Rochester Conference Series on Public Policy*, vol. 42, June, pp. 151–95.

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[1] In fact, in Kashyap and Stein's model, the responsiveness of loan growth to changes in monetary policy is unaffected by binding leverage requirements. Leverage requirements serve to reduce initial loan volume and increase the proportion of securities held in the bank's portfolio (reflecting the fact that securities can be used as a buffer against capital shocks). The sensitivity of loan demand to changes in monetary policy is not affected by a binding leverage constraint because loan growth depends only on the cost of substituting debt financing for deposit financing.