New Evidence on the Lending Channel

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10 September, 2001

Abstract

Do banks play a special role in the transmission mechanism of monetary policy? I use the presence of internal capital markets in bank holding companies to isolate plausibly exogenous variation in the financial constraints faced by subsidiary banks. In particular, I demonstrate that affiliated bank loan growth is less sensitive to changes in the federal funds rate than that of unaffiliated banks, and that these relatively unconstrained banks are better able to smooth insured deposit outflows by issuing uninsured debt. State loan growth also becomes less sensitive to changes in the federal funds rate as loan market share of affiliated banks increases, but state output growth is largely unaffected. JEL Codes: E50, E51

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How does monetary policy affect the real economy? The textbook story, often referred to as the interest rate or money channel, is that the Federal Reserve uses open-market operations to enforce a target for the federal funds rate by managing the aggregate supply of commercial bank reserves. The absence of arbitrage requires that changes in policy interest rates induce similar changes in other short-term interest rates. In the presence of sticky prices, these real changes in the cost of capital drive changes in the interest-sensitive components of demand. Consequently the response of real output to monetary policy in this theory simply depends on how far interest rates move and how elastic spending is to interest rates. In practice, the observed large and lagged response of output to what are generally small and temporary changes in policy interest rates is difficult to reconcile the with the measured weak cost of capital effects on private spending. [1]

The excessive sensitivity of output to monetary policy has prompted economists to look for a financial mechanism – often referred to broadly as the credit channel – through which policy-induced changes in short-term interest rates are greatly amplified. These theories generally involve the presence of asymmetric information that creates financial constraints through an increasing marginal cost of external finance. The balance sheet channel hypothesizes that monetary policy affects loan demand through firm balance sheets. Higher interest rates will erode firm cash flow and reduce net worth. This deterioration in firm creditworthiness increases the external finance premium and effectively reduces firm demand for credit. [2] On the other hand, the lending channel presumes that monetary policy directly affects bank loan supply, forcing bank-dependent firms to reduce investment. Draining deposits from banks will reduce lending if banks face financial constraints when attempting to smooth these outflows by issuing uninsured debt. When banks have acquired an information advantage over time about the quality of their borrowers, firms may

[1] Bernanke and Gertler (1995) discuss this and related issues in more detail. See Caballero (1997) for a survey of the literature on the sensitivity of investment to the cost of capital, or Cummins, Hasset, and Hubbard (1994) for analysis in the context of a natural experiment.

[2] See Gertler and Gilchrist (1994), Oliner and Rudebusch (1996b), or Kashap, Lamont, and Stein (1994) for evidence consistent with a balance sheet channel of monetary policy.

find the credit offered by other banks to be an imperfect substitute. A policy-induced contraction in loan supply thus has much larger effects on investment than is implied by the actual change in interest rates. [3]

The main insight of this paper is that there is a very natural source of cross-sectional variation in financial constraints that identifies a lending channel. In particular, I argue that banks affiliated with multi-bank holding companies are much larger than their actual size indicates, at least in terms their ability to smooth policy-induced changes in insured deposits, due to the presence of internal capital markets. While a small bank faces sharply increasing marginal costs when issuing uninsured debt, a large holding company can raise external funds more cheaply and downstream capital to its subsidiaries. Moreover, as parent companies are obligated to assist subsidiaries in times of trouble, these banks should face weaker financial constraints during normal times. Comparing the response of otherwise similar banks to monetary policy across the size of their affiliated holding company seems to be the right comparision for identifying a shift in loan supply. In contrast to existing research, this strategy plausibly isolates cross-sectional variation in financial constraints and arguably holds constant unobserved differences in the response of loan demand across banks.

The model developed below demonstrates that when deposit insurance is mispriced, banks can use insured deposits to reduce the underinvestment problem created by the presence of financial constraints. Moreover, banks that face tougher financial constraints should rely more on insured deposits to finance new lending. Using multi-bank holding company affiliation as a measure of constraints, I demonstrate that the loan growth of affiliated banks is much less sensitive to insured deposit growth. When there is no difference between reservable and insured deposits, open market operations operate directly on the ability of banks to reduce existing underinvestment problems, creating a lending channel of monetary policy. Consistent with this prediction I find that the

[3] See Kashyap and Stein (1994,1998), Kishan and Opiela (2000) for evidence consistent with a lending channel of monetary policy. See Farrell and Shapiro (1988) for a model of optimal contracts with lock-in consistent with bank-dependence by firms.

loan growth of affiliated banks is less sensitive to changes in the federal funds rate. There is also evidence that these banks are actually better able to smooth the insured deposit outflows created by a monetary contraction by issuing large time deposits and borrowing federal funds. While it seems unlikely that unobserved differences in the response of loan demand to monetary policy explain these results, I show that these findings are robust to recently available controls for small business loan concentration. Finally, I demonstrate that these differences in the response of lending to monetary policy are present across holding company affiliation only since internal capital markets started reducing financial constraints. [4]

I finally find evidence that financial constraints at the bank level affect the equilibrium response of lending to monetary policy. One might be concerned that affiliated banks use their greater ability to smooth deposit outflows to pick up any slack in loan supply left by unaffiliated banks. As interstate branching restrictions have historically meant that commercial banks largely operate in the state where chartered, it seems plausible for much of the last 25 years to treat the US as a collection of state economies. Along these lines, I document that aggregate state loan growth becomes less sensitive to changes in the federal funds rate as loan market share of affiliated banks increases. Having identified a shift in equilibrium lending, I attempt to measure the importance of a lending channel in amplifying changes in the funds rate the real economy. Here the evidence is disappointing, where I find these shocks to loan supply have virtually no effect on state output growth.

While researchers have recently made progress in identifying evidence of a lending channel, there remain some important concerns. Kashyap and Stein (1995, 1998) hypothesize that due to tougher financial constraints, smaller banks will be less able to replace insured deposits with insured debt

[4] I find no evidence that large bank holding companies reduced subsidiary bank financial constraints before 1986. At the same time, there is no evidence of differences in the response of lending to monetary policy across holding company affiliation during this period. Unless there were dramatic changes in unobserved dimensions customer mix of banks affiliated with MBHCs in the 1980s, this is fairly convincing evidence of a lending channel for monetary policy.

and thus be forced to sell liquid assets to fund loan growth. The authors establish that in response to a monetary contraction, the lending of small banks falls relative to large banks and that the lending of small banks is more sensitive to liquidity than large banks. [5] Since large banks tend to concentrate their lending with large firms, however, it is difficult to distinguish a differential response of loan demand to monetary policy across firm size from a differential response of loan supply across bank size. When firms hold deposits at the same bank where they borrow funds – as is frequently required in the covenants of loan contracts – there are also likely differences in the composition of liabilities. [6] Without evidence that large banks are actually smoothing insured deposit outflows better by issuing uninsured debt, this observation is consistent with smaller banks having larger shocks to liabilities. At the same time, even if the differential response of loan growth across bank size and liquidity reflects financial constraints and not customer mix, this is not evidence that the lending channel plays an important role in the transmission mechanism. Large liquid banks could pick up the slack in lending left by small illiquid ones so there are no aggregate consequences of the lending channel.

This paper makes makes several important contributions to the literature. First, there is convincing evidence that differences in the severity of financial constraints affect the response of individual bank lending to monetary policy. Moreover, differences in the response of loan growth across multi-bank holding company affiliation do not appear to be driven by unobserved differences in customer mix. Second, there is evidence that financial constraints affect the response of equilibrium bank lending to monetary policy. As unconstrained banks are unable to reverse the lending response of constrained banks, the lending channel could play an important part in how monetary

[5] Kishan and Opiela (2000) also argue that increasing bank leverage worsens financial constraints. The authors document in aggregated data that there is a differential response of loan growth across bank equity ratios to monetary policy.

[6] It is often argued that one way that banks are able to perform their monitoring function and thus offer finance to firms on better terms than passive investors is by reviewing data on deposit accounts. Loan contracts often contain covenants requiring compensating balances at the bank. Mishkin (1997) argues that compensating balances "make it easier for banks to monitor borrowers more effectively" and thus are an "important credit risk management tool".

policy actually works. The extent to which this shift in equilibrium loan supply actually explains the excessive sensitivity of output to monetary policy is left for future research, but the preliminary evidence is not promising.

Section 1 demonstrates the role of banks in the transmission mechanism with and without financial constraints. I discuss how internal capital markets work in Section 2, and describe the data and descriptive statistics in Section 3. Evidence that internal capital markets identify a lending channel of monetary policy is discussed in Section 4, and directions for future research are outlined in Section 5.

I Theory

Below I sketch of a model of banks' role in the transmission mechanism of monetary policy in order to provide a solid foundation for empirical analysis that follows. I begin with a frictionless world in order to illustrate the passive role of banks in the simple money channel, and then introduce information problems at the bank level in order to build a lending channel. Finally, I illustrate how the presence of a balance sheet channel creates a serious threat to identification. [7]

A Financial intermediation without financial constraints

Banks are firms that extend credit and are largely financed through insured deposits, in contrast to other financial intermediaries – broadly referred to here as non-banks – which are financed completely using uninsured debt and equity. In the absence of information problems that create financial constraints, the loan supply of risk-neutral financial intermediaries does not depend on the fraction of assets financed by insured deposits. While there are institutional factors that might make

[7] Stein (1995) builds a model of the lending channel based on asymmetric information about the value of existing assets. This model is very similar is spirit, and frequently differs more in style and emphasis than substance. The main difference emphasized here is in the motivation for increasing marginal costs in issuing uninsured CDs.

one form of finance relatively more attractive, the opportunity cost of lending is always the fixed interest rate on the uninsured debt instruments of other intermediaries, and is thus independent of how a particular institution is financed.

Assume that banks have monopoly power in the credit market so that the demand for bank loans is downward-sloping. This monopoly power can be motivated either by the presence of legal restrictions on branching within and across states or the presence of significant switching costs created by lender lock-in. [8] For simplicity, I use the following linear loan demand schedule,

$$L_n^d = a - b * r_l \tag{1}$$

Banks finance new loans (L_n) by using insured deposits (D) and uninsured certificates of deposit (CD), being forced to hold a fraction θ of insured deposits as required reserves (R) on account at the central bank. Deposits pay a zero nominal interest rate while CDs pay an interest rate of $r_{cd} \geq 0$. Banks may also purchase the CDs of other banks. [9] For simplicity, the price of deposit insurance is zero. [10] The balance sheet is illustrated in Table (1), and the implied balance sheet constraint is simply.

[8] For a discussion of evidence of branching restrictions and monopoly power see Gilbert (1984) or Kroszner and Strahan (1999). The necessary assumption here is that some firms are bank-dependent in the sense that the credit of other banks is an imperfect substitute for the credit of its current bank. See Farrell and Shapiro (1989) for a model consistent with lender lock-in, or Sushka, Slovin, and Polonchek (1990) for evidence suggesting that firms can be bank-dependent. I do not formally model this dependence here, taking financial constraints at the firm level and the implications of delegated monitoring by banks as given.

[9] I have choosen to refer to all short-term risky debt by large CDs as Romer and Romer (1990,1992) argue that banks are able to smooth deposit outflows with this specific instrument. I intend for CDs to generally represent any form of unsecured debt that banks can use to replace insured deposits. For example, the cross-holdings of other uninsured CDs across banks possibly corresponds to the federal funds market. As banks are risk-neutral, all properly priced all debt instruments are perfect substitutes. Thus the holdings of other banks' CDs could also represent government securities. Of course there are differences in the maturities of these instruments, but making these distinctions does not seem to add much to the model.

[10] Any fixed positive price certainly complicates the analysis, but does not substantively change the results. While the the presence of unfairly priced deposit insurance is crucial our analysis, this does not seem to be an unreasonable assumption. Berger, Herring, and Szego (1995) document that the risk premia implied by the current pricing of deposit insurance is at least an order of magnitude smaller that faced by non-banking firms. In particular, the difference in risk premia charged by the FDIC for the best-rated to worst-rated (in terms of bank examiner's CAMEL ratings) banks was around 8 basis points. Differences in risk-premia on corporate bonds between B- and AAA-rating typically exceed 100 basis points.

$$L_n = (1-\theta)D + CD \tag{2}$$

I finally assume that the quantity of bank deposits is given, motivated by the presumption that this quantity is largely determined by fixed costs in the presence of bank branches that do not affect our short-run optimization problem here. The bank maximizes profits as follows,

$$\max_{L_n} \pi = L_n * r_l - CD * r_{cd} \tag{3}$$

subject to loan demand (1) and the balance sheet constraint (2). First-order conditions imply that unconstrained lending L_n^* sets the marginal revenue of bank credit equal to the marginal cost of finance. When insured deposits are insufficient, banks issue CDs so that the marginal cost is r_{cd}. On the other hand, when insured deposits are in surplus, banks have the option of purchasing CDs so that the opportunity cost of lending is r_{cd}. Equilibrium is illustrated in Figure (1) for each of high and low levels of loan demand (the figure illustrates corresponding marginal revenue curves). The expression $X(D)$ corresponds to the quantity of insured deposits net of required reserves and existing loans, and is simply $(1-\theta)D$. Intermediary lending depends on exogenous factors affecting firm demand for credit, the elasticity of loan demand, and the interest rate on uninsured CD's, that last of which has not yet been determined.

The model is closed with a money market. Assume that risk-neutral agents have a fixed amount of wealth allocated between insured deposits and uninsured certificates of deposit (simply money and bonds), which they view as imperfect substitutes. Non-banking institutions are financed entirely by bonds, which may have a different characteristics, but are perfect substitutes for uninsured deposits. The aggregate supply of insured deposits is simply the ratio of required reserves to the required reserve ratio, $\frac{R}{\theta}$, while the aggregate demand for insured deposits is modeled as a linear

function of the opportunity cost of holding money, the interest rate on large CDs. [11]

$$D^d = \alpha_0 - \alpha_1 * r_{cd} \tag{4}$$

The equilibrium interest rate and aggregate quantity of insured deposits determined by the intersection of money demand D^d with money supply. [12]

B The role of banks in the money channel

Monetary policy affects banks directly by changing the supply of insured deposits and indirectly by changing the opportunity cost of funds. The central bank can target the inter-bank interest rate r_{cd} using open market operations that affect the aggregate stock of required reserves. For example, a monetary contraction motivated by an open market sale of government bonds by the central bank increases the interest rate and reduces the aggregate supply of insured deposits. Figure (1) illustrates that the effect of monetary policy generally does not depend on the composition of external finance or the state of loan demand. [13] The only mechanism though which monetary policy affects bank lending is through the interest rate on uninsured CDs. Changes in the aggregate supply of insured deposits are smoothed away by banks by changing their position in uninsured CDs at constant marginal cost. Given that the stock of wealth is constant, this contraction in loan supply is accomplished by increasing the share of uninsured deposits in agents' portfolios, increasing the marginal cost of intermediating new credit by moving along the aggregate money demand curve. One should note that even in the absence of frictions at the bank level, open-market

[11] This linear specification is used for simplicity. Any downward-sloping money demand function would work, implying that open-market purchases of bonds correspond to expansionary monetary policy. This requires that the income effects created by changes in interest rates are dominated by substitution effects.

[12] Note that I have not specified the mechanism through which aggregate deposits are allocated to individual banks. As long as a bank's insured deposits are weakly monotone in the aggregate supply of insured deposits, putting more structure on this mechanism adds little to the main results below.

[13] If the elasticity of loan demand or money demand changes over the cycle this latter point may not hold. I am unaware of any evidence on either of these points.

operations affect the supply of bank credit. Of course, monetary policy also affects the supply of non-bank credit as the impact on loan growth does not depend on the composition of finance, so that the relative supply of bank credit is unchanged. In the absence of financial constraints, there is consequently no independent role for banks in the transmission mechanism.

C Financial intermediation with financial constraints

The presence of financial constraints now implies that intermediaries will face increasing marginal costs when issuing uninsured debt, so that the cost of replacing insured deposits with uninsured debt will be larger than the opportunity cost of funds. Non-banks will face a standard underinvestment problem, but the presence of insured deposits implies that banks require less external finance and thus may be able to lend up to the unconstrained level when the supply of insured deposits is adequate.

Intermediaries issuing uninsured deposits now have to deal with the presence of asymmetric information that drives a wedge between internal and external costs of finance. I use a reduced-form model of financial constraints with the cost function below, representing the excess that banks will pay over $r_{cd} * CD$ to finance CD in external funds. [14]

$$C(CD, k) = k * CD^2 \tag{5}$$

The parameter k reflects the severity of financial constraints for a fixed level of borrowing. It may be useful in the analysis here to think of this parameter as an indicator function for banks that are not affiliiated with a multi-bank holding company, so that affiliated banks do not face any

[14] Stein (1995) motivates a similar function form by invoking a lemons premium. There is another motivation, however. Assume both insured and uninsured depositors have the same seniority, but banks also issue equity. The risk-premium on uninsured debt will be increasing in the amount borrowed as the capacity for loss absorption per dollar of deposits falls. Higher leverage increases both the probability of failure and the losses of uninsured depositors when the bank fails. When a parent company is committed to downstrem capital to a troubled subsidiary or reduces information problems through close monitoring, this risk-premium will increase faster for unaffiliated banks.

financial constraints. This cost function implies that the marginal cost of uninsured CD's is simply $r_{cd} + k * CD$. [15]

Consider how the presence of an external finance premium changes the bank's optimization problem. As all agents are risk-neutral, the finance premium exists in order that the uninsured CD will yield r_{cd} in expected value. This will permit me to treat the price of CDs asymmetrically, with an expected yield of r_{cd} from the perspective of lenders but costing more from the perspective of borrowers. [16] Banks choose lending to maximize profits

$$\max_{L_n} \pi = r_l * L_n - C(CD, k)1_{CD \geq 0} - r_{cd} * CD \tag{6}$$

subject to loan demand (1) and the balance sheet constraint (2). Affiliated banks (for whom $k = 0$) do not face financial constraints and always lend at the unconstrained level L_n^* described above. When unaffiliated banks (for whom $k > 0$) have a sufficient quantity of insured deposits $X(D) > L_n^*$, it is not necessary for them to borrow using uninsured CDs so that lending is also equal to the unconstrained level. In the more interesting case, insured deposits are inadequate and financial constraints are binding so lending takes the following form

$$L_n \quad = \quad \phi(k)L^* + (1 - \phi(k))X(D) \tag{7}$$

Constrained lending is a convex combination of unconstrained lending L_n^* and insured deposits

[15] It turns out that the functional form is important here. It is possible to re-interpret this model with loan growth as investment and deposit growth as cash flow so that well-known results apply. Given the quadratic production function, a sufficient condition for the loan growth of banks with higher k to be more sensitive to the growth in insured deposits is that this function is increasing, convex and quadradic in the amount borrowed, and well as supermodular in (CD,k). Kaplan and Zingales (2000) point out that more general functional forms generate non-monotonicities in the investment sensitivity of cash flow across k. While I admit that functional forms are crucial in the analysis below, ultimately the question is an empirical one about which there is not convincing evidence.

[16] Implicitly I am assuming that the probability of bank failure is unaffected by loan growth this period. The probability of failure of course could depend on k. Banks only earn profits if they survive or pay fixed bankruptcy costs otherwise.

net of required reserves $X(D)$. The function $\phi(k)$ is decreasing in k so that when constrained, actual lending depends less on unconstrained lending and more on insured deposits as financial constraints increase. It is useful to think about equilibrium for banks and non-banks separately. As non-banks do not issue any insured deposits so that $X(D) = 0$, equilibrium lending is always less than the unconstrained level. This is illustrated by the dashed line in Figure (2). Intuitively, underinvestment problems worsen as financial constraints tighten. The equilibrium is a bit more complicated for banks, as when insured deposits are sufficiently large relative to loan demand, banks do not require any external financing and there is no distortion of lending so that $L_n = L_n^*$. When insured deposits are insufficient, however, bank lending is constrained in a manner that increases with a measure k of the degree of information problems. Each of these cases is illustrated in Figure (2). It should be clear that insured deposits permit banks to reduce the underinvestment problem. The correlation between the reservability and insurability of insured deposits is what gives life to a lending channel of monetary policy as the central bank relaxes or tightens the financial constraints faced by banks.

Before turning to monetary policy, a simple test for any cross-sectional measure of financial constraints in hidden in Equation (7). Affiliated bank lending is never constrained by deposits. On the other hand, unaffiliated lending closely tracks deposit growth when constrained. Differences in the sensitivity of lending to insured deposits across affiliation thus constitutes suggestive evidence that multi-bank holding companies relax the financial constraints faced by subsidiary banks. More generally, there is a monotone relationship between the sensitivity of lending to insured deposits and a continuous measure of financial constraints – like the size of the affiliated holding company. I use this idea below in a test that measures of k are actually correlated with financial constraints. Of course, this test is conceptually equivalent to demonstrating that the the sensitivity of investment is monotone in a measure of financial constraints (like cash flow), and can thus is tied closely to

Fazarri, Hubbard, and Peterson (1988). [17]

D The role of banks with financial constraints: a lending channel

While equilibrium non-bank lending depends solely on the opportunity cost of funds r_{cd} and conditions in the loan market, equilibrium bank lending also depends on the availability of insured deposits. Open-market operations that affect the aggregate supply of insured deposits can now affect the supply of bank loans through an independent mechanism by improving or reducing the ability of banks to solve any existing underinvestment problems. Of course when banks are awash in insured deposits so that underinvestment problems do not exist, the lending channel disappears. The presence of financial constraints at non-banks will still imply that the response of loan growth to monetary policy is not unconstrained, and will generally depend on the severeity of financial constraints.

Consider the sensitivity of lending to open-market operations. Again, the contrast between non-banks and banks is instructive. An increase in the federal funds rate reduces the unconstrained level of lending L_n^* as the marginal cost of external funds increases. Equation (7) demonstrates that the shift in unconstrained lending prompts non-banks to reduce actual lending, but always less than one-for-one. This effect is illustrated in Figure (3), and the change in lending does not vary across the level of loan demand. As contractionary monetary policy is largely accomplished by draining insured deposits from banks through open-market operations, there is potentially a second channel through which banks are affected. Banks that are not constrained by the supply of insured deposits always lend at the unconstrained level, so the response to monetary policy is no different from the economy described above without financial constraints. When binding, draining insured deposits from banks worsens the underinvestment problem, reducing bank lending even

[17] Jayaratne and Morgan (2000) implement this test when using bank leverage as a measure of k, finding that the lending of highly-levered banks is more sensitive to insured deposit growth. These results are replicated below in a broader and much larger sample

further. This second effect is illustrated in Figure (4) for the speical case where money and bonds are perfect substitutes so that there is no change in interest rate. Both of these effects reduce bank lending.

The lending channel is ultimately going to be identified by differences in the response of lending to monetary policy across banks with different marginal costs of external finance. Of course when banks are not constrained by insured deposits, there is no differential response across k as each bank is always lending at the unconstrained level. In the more interesting case where intermediaries are constrained, the differential response of lending to monetary policy across k depends on two competing factors. Policy-induced changes in the federal funds rate have a differential effect on lending across k in the absence of insured deposits. Equation (7) indicates that as financial constraints tighten, lending becomes less sensitive to unconstrained lending L_n^*. This implies that as k increases, lending actually becomes less sensitive to monetary policy. As this case corresponds to the experience of non-banks, it is illustrated for low high k in Figure (5). [18] On the other hand, there is another effect that is likely to dominate this first one. As financial constraints worsen, lending also becomes more sensitive to the growth rate of insured deposits as banks are forced to finance a greater fraction of their loans using uninsured deposits. This second effect implies that as k increases, lending becomes more sensitive to monetary policy. In the case of money and bonds being perfect subsititutes, only this second channel is operational, and it is illustrated in Figure (6). While the net effect of tougher financial constraints on the response of lending to monetary policy is in theory ambiguous, it seems likely that the second channel dominates as money demand appears very elastic and investment demand very inelastic, implying that the direct effect of open-market operations on the unconstained level lending L^* is likely very small. [19]

[18] As the correlation between the response of lending to monetary policy and financial constraints is reversed for non-banks, this might motivate another empirical project on the lending channel. Ludvigson (1998) actually finds evidence consistent with this point in the market for automobile credit, with a stronger response to monetary policy by commercial banks than finance companies.

[19] Of course as monetary policy eventually affects output, there will be lagged effects on unconstrained lending and

The above framework does motivate a simple test of the lending channel. The lending of high k banks should be more sensitive to monetary policy. Moreover, the mechanism through which low k banks are able to shield loan growth is a lower marginal cost of external funds. Thus we should observe that low k banks actually issue more large CDs and borrow more federal funds in response to a monetary contraction. Both of these hypotheses are tested below.

E Threats to identification

Return to the simple model of the money channel outlined above. I model the balance sheet channel by permitting loan demand to depend on the interest rate on uninsured CDs and to depend on the interest rate differently across a measure of the severity of firm financial constraints z. One may think of z as the inverse of firm size, with the creditworthiness of small firms being more interest-sensitive and output-sensitive than large firms. [20]

$$L^d = a_0 - a_1 z - b_0 r_l - b_1 r_l * z + c_0 y + c_1 y * z \tag{8}$$

Demand for credit is reduced by the severity of firm financial constraints z and increased by economic activity y. Moreover, the response of loan growth to monetary policy is now now amplified by the dependence of firm creditworthiness on interest rates. This forumulation also premits differences in the response of loan demand to output across firm size. The response of loan demand to monetary policy across firm size is simply,

$$\frac{\delta^2 L^d}{\delta r_l \delta z} = \beta_1 + c_1 \frac{\delta y}{\delta r_l} \tag{9}$$

the supply of insured deposits. The analysis here – and in most of the empirical literature – focuses on the response of lending in the year following a change in policy where there is little measured change in output.

[20] Gertler and Gilchrest (1994) find evidence that a monetary contraction hurts small manufacturing firms more than large ones.

The demand for credit by small firms is clearly much more sensitive to monetary policy because of the larger interest-elasticity and larger output-elasticity. Figure (7) illustrates how an increase in the funds rate affects lending for two types of firms across two levels of loan demand at different points in the business cycle. [21] As higher interest rates effectively reduce small firm demand for credit, equilibrium lending to small firms falls by more then large firms. This example demonstrates that it is possible to generate spurious evidence consistent with a lending channel when there is positive correlation between k and z – when very financially constrained banks tend to lend to very financially constrained firms. The evidence presented below demonstrates that this concern is very real when using size as a measure of financial constraints but much less of a problem when using multi-bank holding company affiliation. Thus it is going to be important to control as much as possible for differential shifts in loan demand in identifying the lending channel.[22]

II Internal capital markets

The ideal experiment for identifying the lending channel is to somehow change the ability of a commercial bank to smooth any volatility in deposits created by monetary policy without changing its loan portfolio. As indicated below, exploiting variation in bank size and leverage appear to be correlated with differences in the bank loan portfolio so it is difficult to isolate movements in loan supply from those in loan demand. The insight of this analysis is that an individual bank that is affiliated with a multi-bank holding company is really much larger than its actual size indicates – at least with respect to the ease in which it can raise financing to smooth deposits – through the use of

[21] Note that the differential effects of output on the level of firm loan demand have been partialed out in the figure to focus on the differential effects of monetary policy across firms over the business cycle

[22] Note however, that while theory indicates that the lending channel depends on the availability of insured deposits relative to loan demand, the balance sheet channel implied by equation (9) above does not. This implies that asymmetries over the business cycle in the effectiveness of monetary policy could convincingly identify a lending channel. In particular, a third difference (in the response of bank lending to monetary policy across bank financial constraints k) across times when loan supply is unlikely constrained by the supply of insured deposits plausibly eliminates any concern that we are confounding loan demand with loan supply. There is some weak evidence that the lending channel was weaker in the early 1990s when insured deposits were plentiful relative to loan demand.

internal capital markets by the holding company. In particular, the real size of this bank seems to be better captured by the size of its holding company's assets. Exploiting differences in affiliation with multi-bank holding companies will also permit us to hold the actual size, liquidity, and loan portfolio constant, so that we are comparing banks that are otherwise alike as far as differential movements in loan demand are concerned.

One mechanism through which holding company affiliation could reduce financial constraints is through monitoring activity done by the the parent. Stein (1997) outlines a model of internal capital markets by assuming binding credit constraints at both the project and headquarters level. In his model, headquarters can create value if given control rights over the cash flows and collateral of its subsidiaries. In contrast to a bank, as an intermediary headquarters can reallocate scarce resources among divisions to pick winners, adding value by relaxing the financial constraints of the most profitable projects. At the same time, through this monitoring function headquarters may be able to increase the amount of overall external financing of the divisions together. The ability to pick winners separates headquarters from a bank as an intermediary. Since the value of headquarters comes from relative evaluation, it follows that its divisions should all be related so that any evaluation errors are correlated in contrast to a bank which optimally selects a diversified portfolio of projects. Using this mechanism, the parent company can downstream capital to the subsidiary bank to replace an outflow of insured deposits on cheaper terms than an unaffiliaed bank could replace them. The parent could also purchase existing loans from the subsidiary in order to free up funds to finance new loans.

Another important mechanism though which holdng company affiliation is important is the Federal Reserve's source of strength doctrine, where holding companies are counted upon to support subsidiary banks in times of trouble. This gives affiliated banks an option on their balance sheets to downstream funds and be better able to wear financial trouble. More importantly, this

policy extends the liability of the parent beyond its initial equity stake, reducing any moral hazard problems created by debt financing in the presence of limited liability. This option should permit the subsidiary to face better terms of financing in issuing large uninsured CDs in the open market.

There is ample evidence that holding companies operate internal capital markets. Lamont (1997) documents that investment of the non-oil subsidiaries of oil companies was affected by fluctuations in the price of oil in the 1980s. This excessive sensitivity of subsidiary investment to parent company cash flow is interpreted as evidence of financial constraints that are relaxed through the operation of an internal capital market by the parent company. In a related study, Stein and Stultz (1996) find that investment decisions of small divisions of well-diversified firms depend on the cash flows of other divisions. Houston, James, and Marcus (1997) provide evidence that bank holding companies operated internal capital markets throughout the 1980s. Using a sample of approximately 300 publicly-traded multi-bank holding companies 1981-1989, the authors demonstrate that subsidiary loan growth is more sensitive to the non-bank cash flows of the holding company than the cash flows generated by the subsidiary. Moreover, subsidiary loan growth is more constrained by the capital position of the holding company than that of the subsidiary bank. Finally, the authors provide evidence that subsidiary loan growth is negatively correlated with loan growth of other subsidiaries of the holding company. All of these pieces suggest the operation of an internal capital market where the parent deliberately allocates capital across its subsidiaries.

III Data

In the analysis below I use December data on the population of insured commercial banks from Call Reports of Income and Condition, available on-line from the Federal Reserve Bank of Chicago starting in 1976. Annual data is used largely due to space constraints, but I don't seem to have any problem in replicating the main features of previous work at this frequency. In order to construct

consistent time series, I rely heavily on notes created by Kashyap and Stein (1998) to follow changes in variable definitions. Program code is available on request.

I merge the call report data with most recent merger file, identifying years in which banks make acquisitions that create jumps in balance sheet variables unrelated to real economic activity. [23] Instead of following the tradition of force-merging banks with their eventual acquirers, I remove all bank-years in which an acquisition occurs. It should be clear that the ability of a bank to smooth deposit outflows depends largely on its current size and affiliation with a multi-bank holding company, and has little to do with being acquired by another bank or holding company in the future. In constrast to Kashyap and Stein (1998) who remove observations where loan growth is larger than 5 standard deviations from the year-specific mean, I remove influential observations on the basis of the DFITS influence statisic. [24] New loan growth is measured simply as the percentage change in total loans, net of allowances for loan loss. [25] Banks are identified as part of a holding company on the basis of having a direct or regulatory holder identification number, and I identify multi-bank holding companies by counting the number of banks that have the same holder, and match banks to the consolidated balance sheet of the high holder when the data is available.

A Base Call Report Data

The first two columns of Table (2) describe the main features of the data in 1986 and 1996. Consolidation in the banking industry is readily apparent from the decline by 25 percent in the number of banks, the 35 percent increase in average bank size, and the 33 percent decrease in number

[23] The merger file has been recently updated retroactively to identify bank acquisitions of several non-bank institutions.

[24] I have found the results are quite similar when screening on the standard deviation of loan growth, but I found this approach more attractive.

[25] Peek and Rosengren (1995) discuss how a better measure removes net loan sales, loan charge-offs, and transfers to other real estate owned from this measure, each of which correspond to changes in the stock of loans but not changes in the flow of credit. I have not used this insight in the analysis below due to the disappearance of net loan sales from the Call Reports in the mid-1990s, but concede there is certainly measurement error in what will be one of my main dependent variables.

of banks unaffiliated with bank holding companies. The nature of much of this consolidation is alluded to in the decline in percentage of banks affiliated with multi-bank holding companies as banks used newfound powers to consolidate their subsidiaries into branches of a larger bank. [26] The dramatic shift in aggregate bank portfolios towards securities in the early 1990s that has been widely documented in the bank capital literature is not apparent in part because this shift occurred in large banks and in part because it has been completely reversed since. The increase in bank equity ratios, however, is clearly evident. Core deposits represent total deposits less large time deposits, and are as close as we can get to a measure of insured deposits. The bank finance mix is the ratio of core deposits to total deposits plus net federal funds borrowing, and is a measure of the intensity of insured deposits in short-term finance. The first two columns illustrate that almost 90 percent of short-term finance is composed by insured deposits. Finally, internal capital is defined in a manner similar to Houston, James, and Marcus (1998) as the sum of loan loss provisions and net income before extraordinary items relative to total loans.

In 1993 information on the small business lending concentration of a bank's loan portfolio becomes available every June. The data records the aggregate amounts of lending by original loan size for each of commercial and industrial loans and loans secured by farmland, secured by non-farm nonresidential properties, or used to finance agricultural production. While there is not necessarily a perfect correlation between loan and borrower size, there is certainly a precedent set in another literature for making this leap in logic.[27] Banks are asked in each of these four loan categories which on average represent about 50 percent of the loan portfolio to break down the amount of lending by original amount borrowed. I use 250,000 dollars as a cutoff in defining small business loans, and define small business lending concentration as the ratio of loans originated for less than this amount divided by the sum of all loans in each of the four categories surveyed. The second

[26] In many states banks had been forced to branch throughout a state by chartering new banks. See Jayaratne and Strahan (1996) for a description of bank branch deregulation in the late 1980s and early 1990s.

[27] See Peek and Rosengren (1997b) for an example.

column of Table (2) demonstrates that commercial bank loan portfolios are dominated on average with loans to small businesses.

In concert with the introduction of risk-based capital standards, better information on off-balance sheet activities of banks becomes available starting in 1990. In particular, there is extensive data on unused bank loan commitments and letters of credit. Loan commitments represent promises by commercial banks to make loans to firms at some point in the future, while letters of credit are guarantees that banks write to back other debt instruments of firms like commercial paper. The second column of the table illustrates that loan commitments were on average equal to 20 percent of the outstanding stock of loans while letters of credit were less than one percent. That loan commitments are large relative to both the stock and flow of lending implies that they might play an important role in explaining the behavior of loan growth.

B Conventional Measures of k

The third and fourth columns of Table (2) describe using 1996 data differences in bank balance sheets across one popular measure of k – bank size. Consistent with Kashyap and Stein (1998), large banks have assets more than the 95th percentile of the national distribution of assets. Larger banks are typically more aggressive than smaller banks, lending out a larger fraction of assets leaving them with less liquidity in the form of securities. The lower equity ratio of large banks is consistent with tougher financial constraints faced by small banks, implying that it is tougher for them to raise equity so they hold a buffer stock. The most striking difference across bank size comes from the apparent differences in customer mix, with small banks largely focusing their loan portfolios with small businesses and large banks having much more extensive off-balance sheet activities, which typically involve larger firms. Note that if the true measure of agency costs is the consolidated size of a bank's affiliated holding company, on average the agency costs faced by small

banks is overstated by an average of seven times, in comparison to about half as much for large banks. Nine percent of small banks are actually misclassified as small when using the size of their affiliated holding company.

The fifth and sixth columns of Table (2) describe using 1996 data differences in bank balance sheets across another measure of k used in the literature – binding capital requirements. I use banks with a ratio of equity to assets less than six percent as a crude measure of binding standards. The large difference in assets is driven by outliers, with the median assets of banks facing binding requirements less than twice the median assets of everyone else. Note that while large banks focus their lending with large firms, adequately-capitalized banks tend to focus their lending with small firms. As each of these groups conceptually should correspond to banks facing weaker financial constraints, the bias created by differences in unobserved customer mix actually switches sign depending on which strategy is used. This implies one cannot reasonably argue that differences in the small business lending concentration explain why highly-levered banks reduce their lending more in response to a monetary contraction. While exploiting variation across leverage instead of size seems to reduce some of the differences in bank characteristics, there unfortunately is evidence that low capital banks do not face severe financial constraints. In particular, banks with lower equity ratios (and thus higher leverage and k) appear to use core deposits less intensively. These differences are not large, but the sign is inconsistent with the model described above, and is a warning when interpreting any results using this strategy below. [28]

C Holding Company Data

Starting in 1986, I am able to merge information about the parent and consolidated holding company for banks that are part of a bank-holding company. A potentially important sample selection

[28] Houston, James, and Marcus (1997) also conclude that there is little correlation between bank equity ratios and financial constraints.

issue is that only holding companies that have at least 150 million dollars in consolidated assets file the consolidated report. [29] Constructing the consolidated balance sheet is unfortunately not as simple as aggregating the parent and subsidiary bank balance sheets. In the analysis below I exploit differences in the consolidated assets of a bank's affiliated holding company. For banks affiliated with a small holding company, I simply use bank assets in place of consolidated assets as a reasonable approximation. Note that misclassifying some banks as effectively smaller than they really are is a bias against finding that larger holding companies weaken the financial constraints faced by their subsidiaries. [30]

Columns seven and eight of Table (2) illustrate that along most dimensions, differences in bank characteristics are small across holding company affiliation even before conditioning on bank size. While large banks are on average 50 times larger than small banks, banks affiliated with multi-bank holding companies are on average only three times larger than those that are not. Banks affiliated with multi-bank holding companies face agency costs (again approximated by size) that are eight times less then indicated by actual bank size. Note that while 90 percent of banks affiliated with multi-bank holding companies are small (compared to 96.5 percent for unaffiliated banks), only 56.4 are effectively small when using the size of their affiliated holding company. Note that there are also evidence that this affiliation relaxes financial constraints as affiliated banks use insured deposits less intensively than do other banks, although these differences are small. More importantly for our purposes is the large narrowing in customer mix across holding company affiliation, with the difference going from 48 to 8 percentage points, and elimination of the gap in off-balance sheet

[29] There are some exceptions to this rule. Smaller holding companies that have outstanding debt or are directly or indirectly extending credit using financial leverage are required to file this form as well.

[30] Only banks that in which the parent has at least a 50 percent stake are aggregated on to the consolidated balance sheet. The equity claim of other parties in these subsidiaries is reported as a liability under minority interest in consolidated subsidiaries. The parent's stake in other banking subsidiaries is simply recorded as an investment on the asset side of the balance sheet. My attempts to approximate consolidated assets using information using information on the parent's stake in the bank and parent assets have so far failed miserably, with the measurement error systematically understating true consolidated assets.

behavior. The last two columns condition on the small size class, noting that differences are even smaller across MBHC affiliation. Overall, the strategy of exploiting affiliation with large holding companies looks promising relative to strategies that exist in the literature.

D The Federal Funds Rate and Monetary Policy

Following Bernanke and Blinder (1988), I use the federal funds rate as a measure of monetary policy. [31] Figure (8) illustrates the path of the federal funds rate since 1976. Contractionary monetary policy in the early 1980s due to the Volker disinflation pops out of the figure. Note the 300 basis point reduction in the funds rate during the most recent recession, and the large increase in the funds rate in early 1994 when the central bank observed the unemployment rate falling to what was then thought to be the natural rate. That the federal funds rate might be a good indicator of monetary policy is illustrated in Figure (9) by the strong negative correlation with the share of insured deposits in total short-term finance. Changes in monetary policy thus appear to be highly correlated with changes in the composition of bank finance in the right direction, even during Regulation Q years. Increases in the federal funds rate seem to be correlated with a reduction in share of insured deposits in short-term finance, consistent with banks relying more on uninsured debt. As the theory described above indicates that the lending channel operates through changes in the mix of insured deposits in bank liabilities, the federal funds rate seems like exactly the right measure of monetary policy to use in the analysis below. [32]

[31] Kashyap and Stein (1998) document that the funds rate is highly correlated with other measures of monetary policy like the Bernanke-Mihov measure or Boshen-Mills index.

[32] Moreover, concerns that a lending channel might be weaker when there are ceilings on interest rates may be unfounded. What matters for the lending channel (as illustrated in the model above) is the supply of insured deposits relative to loan demand. To the extent that changes in the federal funds rate are well-correlated with open-market operations, which appears to be the case in the figure, there is no reason why the funds rate can't be used throughout the entire period as a measure of monetary policy.

IV Internal Capital markets and the Lending Channel

This section contains the core results of the paper. I first present evidence that a multi-bank holding company appears to reduce the financial constraints faced by its subsidiary banks. Next, I demonstrate that affiliated banks are better able to smooth deposit outflows and shield loan growth from a monetary contraction. These results are robust to recently available controls on small business lending concentration. I also demonstrate that affiliated banks were not any better able to shield loan growth from monetary policy before 1986 when affiliation did not seem to reduce financial constraints. Finally, I demonstrate that financial constraints at the bank level matter for the equilibrium response of lending to monetary policy, but not for the equilibrium response of real variables.

A Preliminary evidence

The first hypothesis motivated from the theory above is consistent with the approach of Fazarri, Hubbard, and Peterson (1988), who test the sensitivity of firm investment to cash flow across a priori measures of financial constraints. This test is also a validation of findings by Houston, James, and Marcus (1997) in a slightly different context and in a much broader and longer sample.

Hypothesis 1

Loan growth becomes less sensitive to insured deposit growth when banks are affiliated with a multi-bank holding company or as the log of consolidated assets of the affiliated holding company increases.

As any measure of financial constraints is weakened, including access to internal capital markets, the model above predicts that banks should be better able to shield loan growth from volatility in insured deposits. Evidence that this is actually the case is described in Table (3), examining the relative sensitivities of loan growth to core deposit growth across several measures of the degree of

information problems. Equation (10) describes the the model actually estimated,

$$\Delta ln(loans)_t = \alpha_0 + \alpha_1 \Delta ln(loans)_{t-1} + \alpha_2 \Delta ln(deposits)_t + \beta X_{t-1} + \gamma X_{t-1} \Delta ln(deposits)_t \quad (10)$$

This is simply a regression of loan growth on a lag of loan growth, insured deposit growth, bank characteristics X_{t-1}, and the interaction of these characteristics with insured deposit growth. The presence of interactions of core deposit growth characteristics other than holding company affiliation reduces the likelihood that this result is driven by unobserved variables that are simply correlated with holding company affiliation.

The first column uses the full sample, while the second column uses data until 1986 and and final two columns use data since 1986. The first column of the table demonstrates that the loan growth of banks affiliated with multi-bank holding companies is less sensitive to core deposit growth, although this is not significant. The coefficient implies being affiliated with a holding comapny reduces the sensitivity of lending to insured deposits on average by about as much as increasing assets by 1.5 percent. That this is not a disappointing result is displayed in the next two columns, which break out each of these coefficients across time.

It is clear that internal capital markets only appear to be working through bank holding company affiliation only in the latter time period, where affiliation is on average equivalent to increasing assets by almost 3 percent. It is highly plausible to find internal capital markets working only in recent years because holding companies were largely vehicles used to circumvent intra-state branching restrictions. With little of value at the parent company other than equity claims on subsidiary banks, any option these banks had to receive support in times of trouble was worthless.

[33] Uninsured depositors also did not suffer many losses until the early 1980s when banks actually started to fail with some regularity, so affiliation might not have been much of an funding advantage until investors realized there was actually risk in holding these instruments.

The fourth column replaces a dummy for multi-bank holding company affiliation for the log of consolidated assets, making it clear that being part of a larger holding company also reduces financial constraints. The table also illustrates that low capital increases the sensitivity while the size of capital surplus (over 6 percent) and internal capital generation reduce the sensitivity of lending to insured deposit growth. There is little evidence, however, that bank liquidity (measured by securities holdings) reduce the sensitivity of lending to insured deposit growth. In the end there seems to be evidence that holding companies have reduced the financial constraints faced by their affiliated banks since 1986, implying we should find the lending of affiliated banks to be less sensitive to monetary policy during the period, and no different in the years before. We test each of these hypotheses below.

B Baseline evidence

We am of course not interested in the sensitivity of loan growth to any variation in deposits, but rather how loan growth responds to the volatility in insured deposits created by monetary policy. When there is little meaningful difference between reservable deposits and insured deposits – as is currently the case in the US banking system – a monetary contraction effectively reduces the aggregate supply of licenses to issue insured deposits. Banks will have a differential ability to replace outflows of insured deposits by issuing uninsured CDs and borrowing federal funds due to financial constraints. As the evidence above suggests that affiliation with a multi-bank holding

[33] One of the first ways banks were permitted to branch throughout a state was through a holding company. These affiliated banks were also likely to have very correlated loan portfolios because of interstate branching restrictions, which were in place until the mid-80s. As holding companies were able to acquire across state lines the correlation between bank loan portfolios fell, increasing the value of the option. See Jayaratne and Strahan (1996) for a full discussion of bank branch deregulation.

company seems correlated with financial constraints, it seems natural to look for a differential response of lending to changes in the funds rate across affiliation. This leads us to consider the following hypothesis.

Hypothesis 2

Loan growth is less responsive to changes in monetary policy when banks are affiliated with a multi-bank holding company or as the log of consolidated assets of the affiliated holding company increases.

As this model uses consolidated assests of the holding company as a measure of financial constraints, I employ annual data on the population of insured commercial banks over 1986-1999. Baseline results are reported in Table (4), and the actual model estimated is displayed in Equation (11),

$$\Delta ln(Y)_t = \alpha_0 + \alpha_1 \Delta ln(Y)_{t-1} + \beta_1 X_{t-1} + \beta_2 M_t + \beta_3 X_{t-1} M_t \tag{11}$$

Each dependent variable $\Delta ln(Y)_t$ is regressed against a set of macro variables M_t, a set of lagged bank characteristics X_{t-1}, and interactions of the macro and bank characteristics. The presence of bank variables other than holding company affiliation interacted with the macro variables imply we will be comparing the response of banks that are similar on the basis of observable characteristics except for affiliation.

These macro variables include the one-year change in the federal funds rate, aggregate nominal output growth, and inflation measured by the consumer price index, each lagged by one quarter. In addition to affiliation with a multi-bank holding company, in the first column X_{t-1} includes include the log of total bank assets, the liquidity ratio, and equity ratio in the spirit of the discussion above. The interaction of each measure with aggregate output growth is in place to capture differential changes in loan demand across banks in response to any change in output. The second column for

each dependent variable adds to X_{t-1} broad information about the banks' loan portfolio composition and internal capital generation, and interacts this with each of the macro variables.

I also find that it is important to control for the impact of risk-based capital on bank lending, and permit bank characteristics X_{t-1} to affect lending differently over the time period 1990-1993. This is accomplished by adding a dummy for this time period and its interaction with X_{t-1} to all specifications. While this is not entirely satisfying, I find similar results for the the time period 1993-1999 where changes in capital standards were not important. [34]

The table reports coefficients and standard errors on the interaction variables, and all standard errors are corrected for heteroskedasticity and clustering at the bank level. [35]

The first two columns of Table (4) demonstrate that being affiliated with a larger holding company generally reduces the response of loan growth to changes in the federal funds rate when comparing banks of equal size, capital position, liquidity, and internal capital. The second column demonstrates that these results are not driven by differences in portfolio shares across the size of the holding company. In the context of a 100 basis point funds rate hike, internal capital markets seem to reduce the response of loan growth by about 40 basis points. Short-term finance is defined as the sum of total deposits and federal funds borrowing and the coefficients are of plausible magnitude given those on lending. [36]

When shocks to insured deposits are accompanied by differential shocks to loan demand or liabilities across the severeity of financial constraints, it is not clear that differences in the response

[34] Conceptually, the right thing to do would be to use an accurate measure of risk-based capital ratio in 1989, and place this variable and its interaction with the time period dummy in the regression above. Approximations to risk-based capital before 1990 are quite poor, however, as reporting lagged the change in capital standards. In looking to pursue this avenue, I recently learned from that the Board of Governors has actually "deep-sixed" programs that constructed RBC measures during this period due to their "gross inaccuracy". So I stick with the reduced-form approach for now.

[35] I have also experimented with weighting regressions by the inverse of the number of banks in each year to ensure that the earlier time period (when there were many more banks) does not receive relatively more weight in estimates, as there is no a priori reason to allow such a weighting, but this does not seem to affect results qualitatively or statistically. The regressions in table are unweighted.

[36] Note loans correspond to about half of assets while short-term finance represents almost 90 percent of libilities and equity, implying coefficients on the latter should be much smaller for the two to be consistent.

of loan growth identify a lending channel. Moreover, the model above predicts that the mechanism through which effectively larger banks are able to shield loan growth from monetary policy is through a greater ability to issue uninsured deposits. Without evidence that banks facing weaker financial constraints are actually able to more easily issue uninsured deposits, it is difficult to interpret evidence of a differential response to loan growth across some measure of agency costs as consistent with a lending channel. The absence of evidence anywhere in the literature that large banks actually do smooth insured deposit outflows by issuing large CDs is worrisome. This leads us to consider the following hypothesis.

Hypothesis 3

The growth of uninsured debt is more sensitive to changes in monetary policy when banks are affiliated with a multi-bank holding company or as the log of consolidated assets of the affiliated holding company increases.

That banks are able to smooth insured deposit outflows is illustrated by the second two columns, tracking the growth rate of total-short term finance, itself comprised of total deposits and federal funds borrowing. The first two columns of Table (5) break out the response of short-term finance by the growth rate of insured deposits by the growth rate in uninsured deposits and federal funds borrowing in second two columns. The response of uninsured deposits (which include large CDs and federal funds borrowing) to monetary policy across holding company affiliation relative to insured deposits is particularly striking. While affiliated banks have smaller outflows of insured deposits in response to policy, the response of uninsured deposits is almost four times as strong. It is also noteworthy given the existing literature that large banks actually fail to use their size to replace uninsured deposits better than smaller banks do, but this is an issue deserving further study.

It is reasonable to be a bit concerned about the observed response of core deposits. If there are unobserved differences in customer mix on the liability side of a bank's balance sheet, the

differential response of loan growth described above might not have anything to do with financial constraints. There are several reasons, however, not to put much faith in this argument here.

The first argument is that the response of core deposit growth could simply reflect the workings of internal capital markets. A sizeable portion of gross flows with the parent holding company correspond to the parent company's deposits in subsidiary banks. It is certainly possible that the mechanism through which internal capital markets work is for the parent to channel funds raised by the holding company to subsidiary banks through insured deposits. A parent company can downstreamfunds to a subsidiary through short-term loans, buying uninsured CDs issued by the subsidiary, or placing insured deposits. Which method is actually employed might vary across holding companies and over time depending on the needs of the parent and tax issues involved. Second, the measure of core deposits used here actually includes some uninsured deposits. In particular, the balance of transactions and savings accounts above 100,000 dollars is generally not insured. Part of the response of core deposits thus represents the greater ability of affiliated banks to keep large uninsured depositors in the bank. Third, I demonstrate in the next section that controls for small business loan concentration and the amount of outstanding loan commitments – two plausible measures of customer mix – do not affect to response short-term bank finance to monetary policy. Fourth, I fail to find any evidence below that these financial constraints actually amplify the impact of monetary policy on the real economy. If these were loan demand shocks one would expect to see some movement in real variables to drive them. Finally, controlling for core deposit growth in the previous table does not qualitatively change our results, although the size of coefficients are smaller, but still significant. As is such, I interpret the differential response of insured deposits as the workings of internal capital markets, and focus on the rest of this paper on short-term finance, which is defined as the sum of insured and uninsured funds.

C Small Business Evidence

While the ability to compare banks that are observationally equivalent except for their affiliation with a multi-bank holding company should reduce the likelihood that this strategy exploits unobserved variation in bank customer mix, I replicate the analysis above using small business loan concentration controls available starting in 1993 in Table (6). The first two columns demonstrate that the reduced-form effect of MBHC-affiliation is much stronger in the recent data, and if anything are strengthened by controlling for previously unobserved differences in small business loan concentration. Columns three and four illustrate qualitatively similar results for the growth rate of short-term finance, although this variable is not as sensitive to the controls for customer mix.

Interestingly, the sign on the interaction of small business lending with the change in federal funds rate is positive and significant, implying that the response of total loan growth to monetary policy is actually weaker as small business loan concentration increases. As banks affiliated with multi-bank holding companies generally lend less on average to small businesses (see descriptive statistics above), this explains why the coefficient on loan growth increase in column (2). On the other hand, the sign on small business lending is entirely inconsistent with previous literature on the balance sheet channel. Looking at the path of the funds rate in Figure (8) above, there certainly appears to be enough variation in monetary policy with a 300 basis point increase starting in 1994. One possible explanation is that this increase in the funds rate was not correlated with a slowdown in output growth. Previous research on the balance sheet channel uses Romer dates, where a shift towards contractionary montary policy is usually followed by a recession. [37] Strong economic growth may have ameliorated any balance sheet effects. In any case, what is important is that differences in customer mix do not seem to explain why the response of loan growth to monetary policy is much weaker across MBHC affiliation, ruling out the main threat to identification.

[37] See Gertler and Gilchrist (1994) for example.

D Overidentifying Evidence

The analysis above used consolidated assets of the holding company as a measure of financial constraints, and thus focused on the later time period (since 1986). Recall that the data suggested that this was also the time period when internal capital markets seemed to actually reduce the sensitivity of lending to core deposit growth. It should thus be the case then that the response of affiliated bank lending to monetary policy is not very different from unaffiliated banks in the period before 1986. If the differences between above were to persist before 1986, one might be concerned that they simply captured unobserved differences in the customer mix (beyond firm size) across holding company affiliatoin. Unless there have been dramatic changes in the customer mix of banks across holding company affiliation between the early 1980s and 1990s, however, this strategy is potentially the nail in the coffin to identify the lending channel.

As consolidated assets are not available before 1986, I use affiliation with a multi-bank holding company as the measure of financial constraints of interest. I simply difference the coefficient on the interaction of holding company affiliation with monetary policy across the two time periods, and results are illustrated in Table (7). The results are pretty clear, with the coefficient on the interaction with a dummy for the early time period being nearly the opposite of the coefficient in the later time period. These differences are highly statistically significant, and indicate there was no lending channel in the early time period when using multi-bank holding company affiliation as a measure of financial constraints. I find this to be the most convincing evidence to date that banks are an important part of the monetary transmission mechanism.

E Aggregate Evidence

Having identified evidence of differential responses to bank loan supply to changes in the federal funds rate, the next step is to identify whether or these correspond to changes in aggregate loan

supply and eventually affect the investment decisions of bank dependent firms. On one hand, it is plausible that banks affiliated with multi-bank holding companies issue uninsured debt in order to pick up the slack in lending created other banks so that the observed difference in bank loan growth across access to internal capital markets corresponds to no change in aggregate lending. [38] On the other hand, it is not clear that changes in monetary policy don't have qualitatively similar but quantitatively smaller effects on other types of banks, as banks affiliated with multi-bank holding companies could also struggle to smooth loan growth (although by not as much as unaffiliated banks) so that the bank-level analysis actually underestimates the aggregate importance of the lending channel. These issues are crucial when evaluating the importance of the lending channel in the transmission mechanism of monetary policy. Without evidence that financial constraints for banks actually affect the response of equilibrium lending to monetary policy, it is possible these frictions play no role in amplifying the response of real output to changes in the federal funds rate.

Identifying convincing evidence of a distinct lending channel in the aggregate data has been extremely difficult. While Bernanke and Blinder (1992) document that changes in aggregate lending usually lag changes in monetary policy, it is not clear if these changes are caused from the supply side by the presence agency problems in banks or from the demand side by firms reacting directly through the more traditional money channel. There is strong evidence of a balance sheet channel that amplifies changes in interest rates by affecting firm cash flow and net worth, which in turn affects firm creditworthiness. Gertler and Gilchrest (1994) document that among manufacturing firms, smaller firms bear the brunt of a decline in activity and slowdown in inventory demand. [39] Weaker firm balance sheets effectively reduce the demand for credit, implying that a lagged decline

[38] It is certainly possible that other firms pick up any slack in lending through trade credit or the slack in output. These possibilities are less plausible given the convincing evidence described by Peek and Rosengren (1997a) that plausibly exogenous changes in the loan supply of US branches of Japanese banks seem to have affected output in the real estate industry. Thus I feel that the real gap in our understanding is whether or not monetary policy actually induces shifts in the aggregate supply of bank credit (relative to the supply non-bank credit).

[39] See Hubbard (1994) for a complete discussion of the balance sheet and lending channels.

in bank lending in response to tighter monetary policy could plausibly be caused either through the balance sheet or lending channel. Kashyap and Stein (1993) attempt to solve this identification problem through the observation that while higher interest rates should reduce the demand for all types of credit through the balance sheet channel, the supply of bank credit is reduced and demand for non-bank credit it increased through the lending channel. The lending channel is consequently identified by changes in the aggregate mix of bank and non-bank credit following changes in the stance of monetary policy. Moreover, the authors demonstrate that the aggregate credit mix is an important explanatory variable in several traditional investment equations. [40] Friedman and Kuttner (1993) unfortunately find in a VAR framework that any shock that reduces aggregate output also tends to increase the mix, implying these changes in the mix may not have anything to do with the lending channel. [41]

The absence of convincing evidence in existing aggregate studies motivates the following hypothesis.

Hypothesis 4

The presence of bank-level financial constraints amplifies the equilibrium response of lending to monetary policy.

In order to test that changes bank lending are actually corresponding to changes in equilibrium lending and output, I aggregate up bank behavior to the state level to look for differences in the response of state loan and output growth across the loan market share of banks affiliated with multi-bank holding companies. Interstate branching restrictions have historically meant that commercial

[40] A closer look at what is driving changes in the mix, however, is less persuasive. As small firms have little access to nonbank credit, variation in the aggregate mix is driven by the large firm mix and allocation of bank debt across firm sizes. While there appears to be a shift in the mix for large firms, Calomiris, Himmelberg, and Wachtel (1994) find that any increase in non-bank credit (measured by commercial paper) does not appear to occur in the same firms that have bank lending reduced.

[41] When including trade credit in nonbank lending, Oliner and Rudebusch (1996a) find much of the variation in the aggregate mix is driven by changes in the large firm share of bank debt, although these facts and their implications for the lending channel are disputed in Kashyap and Stein (1996). The crucial issue is whether or not there are changes in the terms on which credit is extended to firms, combined with how sensitive firm output is to these terms.

banks largely operate in the state where chartered, so for much of the last 25 years it seems plausible to treat the US as a collection of state economies.[42] As with the microdata analysis above, it is possible to difference the response of loan growth across the loan market share of banks affiliated with multi-bank holding companies, holding constant all other characteristics of a state's banking industry constant. Included as controls are aggregated state banking assets, liquidity, equity ratio, internal capital, fraction of banks with low capital ratios, and portfolio composition shares. I also control for the loan market share of small banks, and in the later data control for the small business lending concentration of banks affiliated with MBHCs and small banks separately.

Despite all of the consolidation that occurred in the banking industry over the last 20 years,the average state loan market share of small banks only fell by around 4 percentage points. The trend increase and in the loan market share of banks affiliated with multi-bank holding companies combined with the trend decrease in fraction of affiliated banks described above is consistentwith much of this consolidation occuring as large holding companies merge and consolidate their subsidiary banks into branches. There are large differences in customer mix across the loan market share of mall banks at this intermediate level of aggregation. Moreover, differences in customer mix across multi-bank holding company affiliation are actually larger than they appeared in the micro data.

I should note that the implications of unobserved customer mix for identification may be different at the state level than the bank level. If the composition of small firms in a state is fixed after controlling for state industrial structure, exploiting differences in the loan market share of either small or affiliated banks may mechanically induce variation in aggregate customer mix. The presence of important balance sheet channel effects at the bank level make identification at the

[42] Obviously this because a poor assumption in recent data with the advent of interstate branching. I have recently used branch-level data from FDIC Summary of Deposits in order to identify the deposit market share of banks affiliated with multi-bank holding companies, presuming it is correlated with the loan market share. As the FDIC data identifies the allocation of bank deposits across branches, it is possible to get a better measure of bank activity in a particular state. Despite this potentially cleaner measure of state-level financial constraints, the results are almost identical to those reported below.

state level much more difficult. [43] Of course the data above suggest that over the period when small loan concentration controls are available, accounting for differences in customer mix only strengthens the lending channel. In any case, I think a much more careful treatment of these issues is necessary, and view these aggregate results only as suggestive.

This strategy is implemented in Table (8). The actual equation estimated is described in Equation (12),

$$\Delta ln(Y)_{st} = \alpha_0 + \alpha_1 \Delta ln(Y)_{st-1} + \beta_1 M_t + \beta_2 X_{t-1} + \beta_3 M_t X_{t-1} \tag{12}$$

The dependent variable $\Delta ln(Y)_{st}$ is alternatively aggregate state loan growth and the growth rate of gross-state product. The macro variables are identical to above, and the state banking characteristics are simply those above aggregated to the state level.

Panel A is estimated over the full time period 1976-1999, Panel B is estimated since 1987, and finally Panel C is estimated over a more recent period when better controls are available. The first column simply regresses state loan growth on a lag of loan growth, main effects for changes in the funds rate, nominal aggregate output growth, inflation, small bank loan market share, and the loan market share of MBHCs, in addition to interactions of the latter two variables with macro variables. The second column adds state controls state bank capitalization, asset size, and liquidity, each also interacted with macro variables. The first row indicates that the state impulse response of loan growth to a change in the federal funds rate is actually mitigated by the loan market share of MBHCs. In the context of a 100 basis point increase in the federal funds rate, an increase in the loan market share of MBHCs from zero to 100 percent reduces the response of loan growth by 90 basis points. The results in Panel B are generally larger but statistically weaker, and similarly with

[43] There does appear to be a significant negative correlation between the loan market share of multi-bank holding companies and their small loan concentration, even with a full set of state-level controls. While the question of whether or not this is causal is a matter of lively debate, only the correlation is relevant here. See Peek and Rosengren (1997b) for a recent discussion.

Panel C which also adds controls for the small business loan concentration of affiliated and small banks with proper interactions. The increase in size of the lending channel over time is consistent with the bank-level results that suggest internal capital markets were relevant only in the recent time period.

This evidence suggests that there are differential shifts in loan supply across a measure of state-level financial constraints. The big question of course is whether or not these translate into differential movements in state output, and is the final hypothesis tested in this paper.

Hypothesis 5

The presence of bank level financial constraints amplifies the equilibrium response of real output to monetary policy.

The final two columns of Panel A in Table (8) demonstrate that over the full period, there is no such evidence. The response of gross state product growth to monetary policy is not significantly weakened by the loan market share of banks affiliated with multi-bank holding companies. Controlling for the small loan concentration of affiliated and small banks in Panel C does little to change this result, although the coefficients are much larger. The implied elasticities of real output growth to bank loan growth are very small (less than percent and not different from zero). [44] Before being too negative, it should be noted that this approach at best identifies a lower bound on the size of the lending channel. If banks that are affiliated with multi-bank holding companies also struggle to replace insured deposits in a qualatatively similar but quantatively similar fashion as unaffiliated banks, this strategy understates the response of equilibrium lending to monetary policy. In other words, holding company affiliation is but one of many dimensions of financial constraints that could make banks an important part of the transmission mechanism. It is possible exploiting other dimensions could change this result. There is also a more subtle issue of timing to consider.

[44] This result is not without precedent. Driscol (1998) uses money demand shocks to conclude that changes in lending have small and economically insignificant effects on state output.

The measured response of aggregate output to an innovation in the funds rate is very small in the first four quarters. As the peak effect on output does not occur until after eight to twelve quarters, limiting the analysis to the first year might not be the best thing to do. I am currently investigating these issues in greater detail. [45] For now, I conclude that there is evidence that financial constraints amplify the response of equilibrium lending to monetary policy, but provide no such amplification for the response of real variables.

V Conclusions

At the end of the day, there is convincing evidence that changes in monetary policy affect the aggregate supply of bank credit. Banks affiliated with multi-bank holding companies face weaker financial constraints. Moreover, these banks appear better able to smooth deposit outflows and shield loan growth from a monetary contraction. Finally, there is evidence that financial constraints at the bank level affect the equilibrium response of lending to monetary policy.

More work certainly needs to be done documenting exactly how holding companies are able to downstream funds to their subsidiaries through internal capital markets. I have been working with the bank holding company data in identifying the gross flows of funds within a holding company, trying to identify the right correlations across holding company size and across changes in the federal funds rate. It would also be nice to have supporting evidence for a story of why affiliation has mattered since 1986 but did not before then.

I also presented new evidence on the operation of a balance sheet channel in more recent data. Using small business loan concentration information, I demonstrated that the loan growth of banks that concentrate their lending with small firms was actually less responsive to changes in the federal funds rate since 1993. This result might be explained by the fact that the monetary contraction

[45] See Christiano, Eichenbaum, and Evans (1998) for a full discussion.

that occured in 1994 was not accompanied by a slowdown in output. It is also possible that there were other shocks to the profitability of small firms that offset this increase in the cost of capital. In any case, it seems prudent to update research on the balance sheet channel with more recent data, and perhaps new methods. There is no reason why the source of cross-sectional variation in financial constraints exploited here – internal capital markets in holding companies – couldn't be used to identify balance sheet effects in firm micro data.

The largest task of future research, however, is to document the extent to which these changes in loan supply actually amplify the response of output to monetary policy. I presented weak results above when differencing the response of output growth to monetary policy across the loan market share of multi-bank holding companies. Standard errors were consistent with a wide range of hypotheses about the aggregate importance of the lending channel. I believe that the most convincing evidence will probably come from matching firm micro data with the Call Reports. In any case, there is still much work to do.

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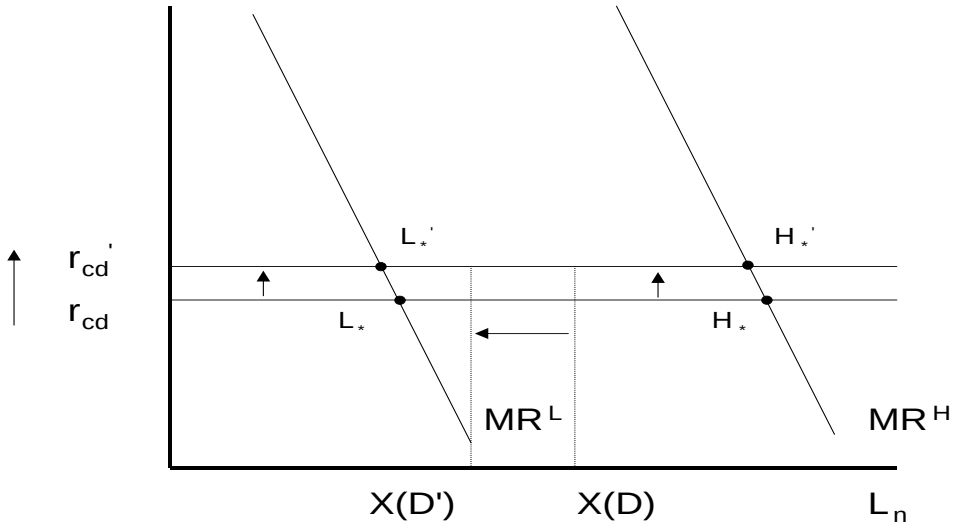

Figure 1: Frictionless Response to a Monetary Contraction

Table 1: Bank Balance Sheet

Assets	Liabilities and Equity
Reserves (R)	Insured Deposits (D)
Uninsured Deposits (CD^-)	Uninsured Deposits (CD^+)
New Loans (L_n)	

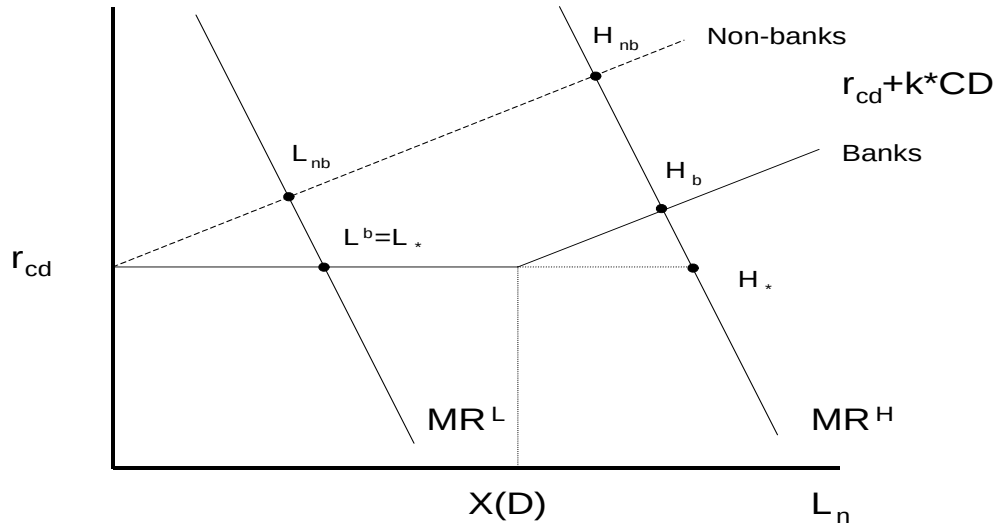

Figure 2: Equilibrium for Banks with Financial Constraints

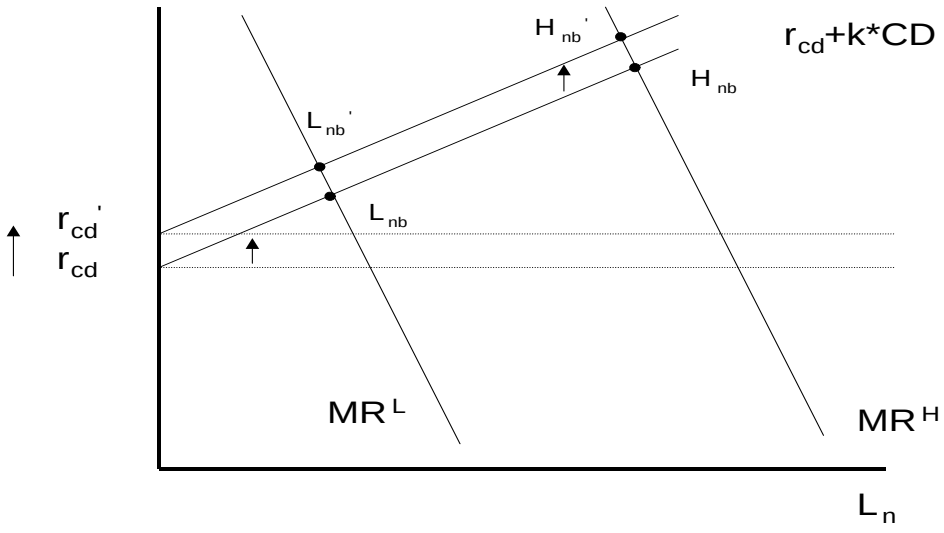

Figure 3: Non-bank Response to a Monetary Contraction with Financial Constraints

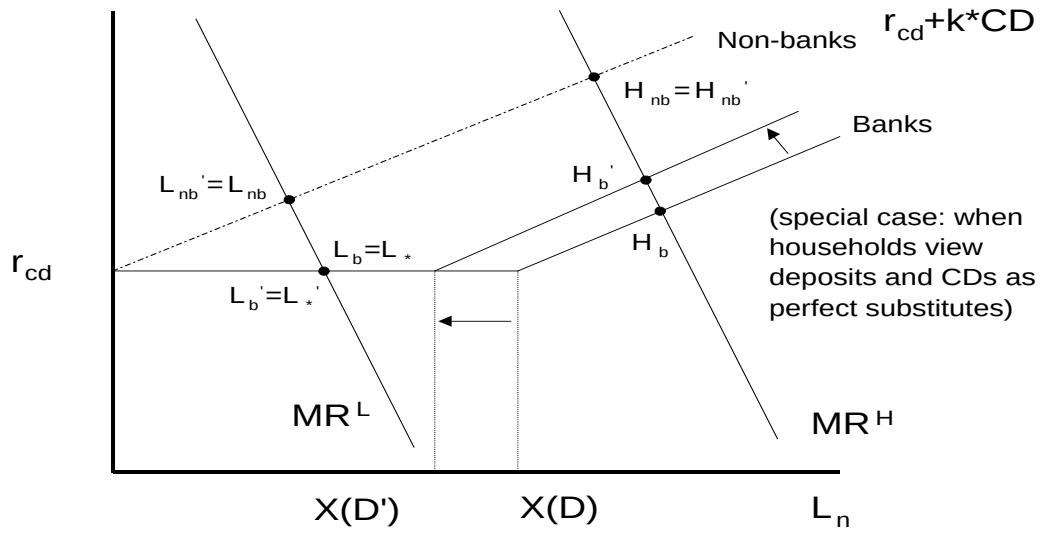

Figure 4: Bank Response to a Monetary Contraction with Financial Constraints

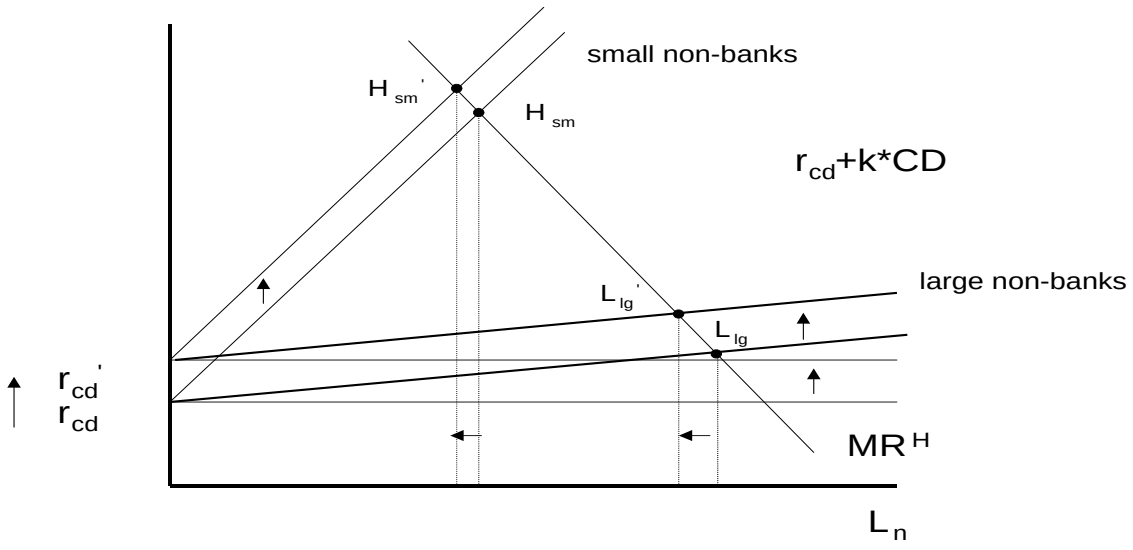

Figure 5: Non-bank Response to a Monetary Contraction with Financial Constraints: II

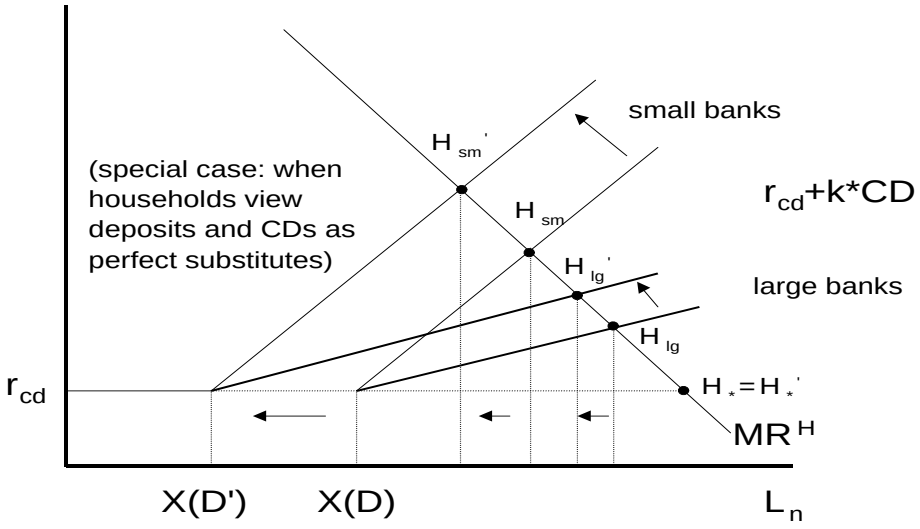

Figure 6: Bank Response to a Monetary Contraction with Financial Constraints: II

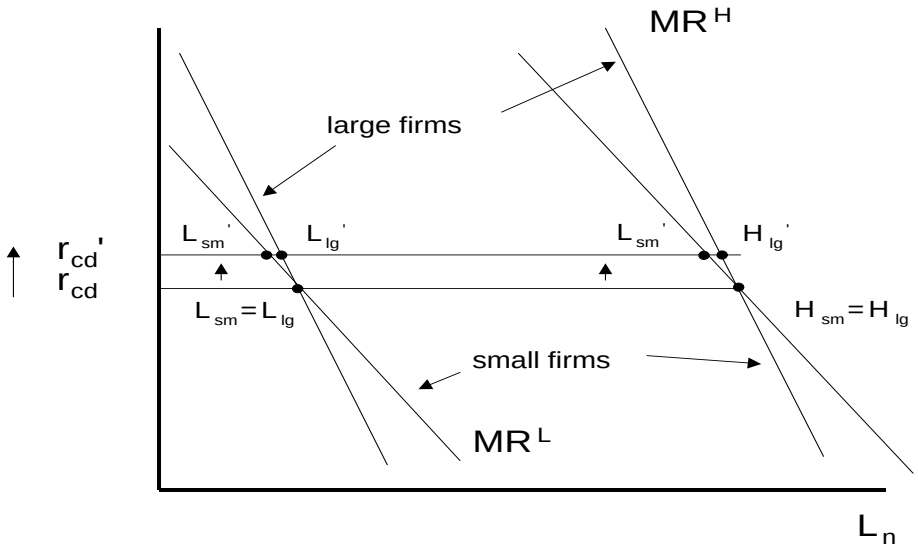

Figure 7: Threats to Identification

Figure 8: Federal Funds Rate

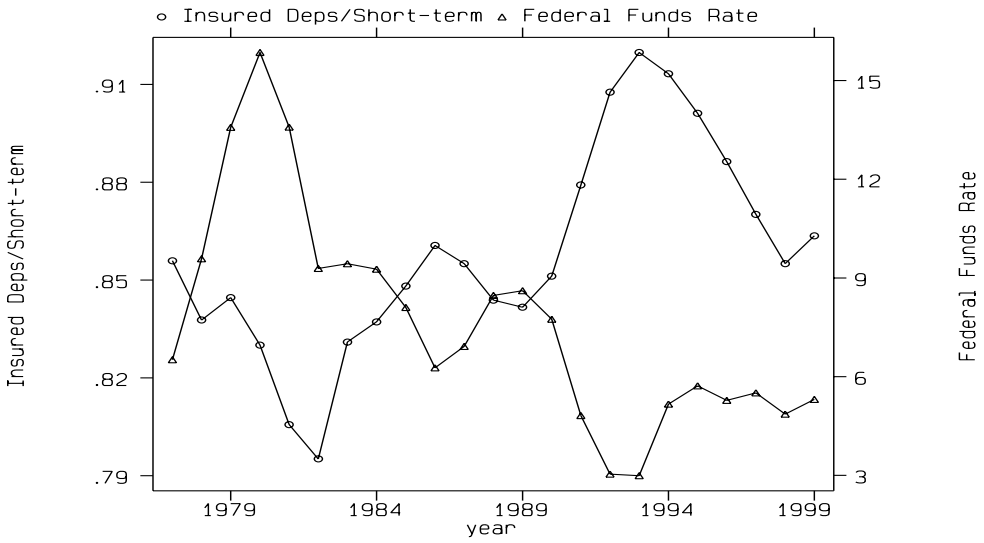

Figure 9: Bank Short-term Finance Mix Versus the Funds Rate

Table 2: Descriptive Statistics

	All Banks		Size		Leverage		Multi-bank holding company affiliation			
	1986	1996	Small	Large	Low	High	One-bank	MBHC	One-bank	MBHC
Assets	189	255	80	3,615	213	2,975	167	534	75	95
Loans	51.7	57.7	57.4	62.1	57.6	60.1	56.8	60.6	56.6	60.2
Small loans		75.9	77.9	29.7	76.2	56.0	77.9	69.6	79.3	73.1
Securities	35.3	34.2	34.5	28.2	34.2	29.1	35.1	31.2	34.2	31.9
Core deposits	78.6	76.2	76.8	65.4	76.3	73.7	76.3	75.8	76.8	76.9
Equity	8.6	10.4	10.4	9.0	10.5	5.4	10.6	9.6	10.7	9.7
Finance mix	87.6	87.2	87.6	76.7	87.2	82.3	87.4	86.3	87.8	87.1
Loan losses	1.6	1.6	1.6	1.8	1.6	1.7	1.6	1.6	1.6	1.5
Internal capital	7.0	6.0	5.89	9.4	6.1	4.2	5.8	6.8	5.7	6.6
Loan commitments		19.2	16.6	76.9	19.3	16.9	18.5	21.4	16.0	18.8
Letters of credit		0.9	0.7	4.9	0.9	1.8	0.8	1.2	0.7	0.7
Holding company	68.2	77.2	76.6	89.5	77.2	77.2	70.0	100	69.6	100
Multi-bank company	29.0	24.0	22.9	45.8	23.9	30.9	0	100	0	100
Consolidated assets	1,106	1,224	590	13,400	1,028	13,900	220	4,396	87	2,283
Small bank	95.0	95.0	100	0	95.3	75.6	96.5	90.5	100	100
Small holding company	83.0	86.5	91.0	0	86.8	65.0	96.1	56.4	99.6	62.2
Binding leverage	14.1	1.5	1.2	7.5	0	100	1.4	2.0	1.3	1.1
Loan growth	5.6	12.3	12.3	12.4	12.2	16.1	12.5	11.7	12.4	11.9
Core deposit growth	10.6	7.6	7.6	7.6	7.5	12.0	7.8	6.9	7.8	7.0
Number of insured banks	12,823	8050	7650	400	7927	123	6114	1936	5897	173

Table Notes: Data refer to the population of insured commercial banks. Assets and consolidated holding company assets are reported in millions while all other variables are reported in percentage terms. Loans, securities, core deposits, and equity are measured relative to assets. Small loans are measured relative to total loans covered the small business loan supplement. The finance mix is the ratio of core deposits to the sum of total deposits and net federal funds borrowing. Loan losses, internal capital, loan commitments, and letters of credit are measured relative to total loans. Small banks and small bank holding companies are defined at the 95th percentile of the national distribution of bank assets. Binding leverage standards are approximated by an equity ratio of less than six percent.

Table 3: Sensitivity of Loan Growth to Core Deposit Growth

	1976-1999	1976-1986	1987-1999	
Intercept	-0.0448	-0.1316	-0.0004	-0.0123
	(0.0174)	(0.0118)	(0.0178)	(0.0167)
$\Delta ln(deposits)$	1.4767	2.2169	1.3238	1.4460
	(0.1876)	(0.1185)	(0.2838)	(0.2647)
MBHC affiliated	0.0092	0.0056	0.0073	
	(0.0060)	(0.0030)	(0.0057)	
ln(assets)	0.0060	0.0132	0.0027	0.0074
	(0.0018)	(0.0012)	(0.0017)	(0.0025)
Securities	0.0360	0.0910	0.0207	0.0213
	(0.0094)	(0.0082)	(0.0107)	(0.0103)
Capital Surplus	0.1604	-0.0868	0.1388	0.0816
	(0.0724)	(0.0332)	(0.1044)	(0.0860)
Binding Leverage	-0.0325	-0.0062	-0.0664	-0.0638
	(0.0035)	(0.0071)	(0.0036)	(0.0037)
Internal Capital	-0.0003	0.0087	-0.0002	-0.0001
	(0.0003)	(0.0077)	(0.0003)	(0.0002)
ln(assets)$*\Delta ln(deposits)$	-0.0801	-0.1501	-0.0654	-0.0183
	(0.020)	(0.0125)	(0.0280)	(0.0396)
MBHC$*\Delta ln(deposits)$	-0.1285	-0.0451	-0.1774	
	(0.0713)	(0.0271)	(0.0876)	
Securities$*\Delta ln(deposits)$	0.0267	-0.2406	0.1388	0.1822
	(0.1606)	(0.0739)	(0.2558)	(0.2013)
Capital Surplus$*\Delta ln(deposits)$	-0.3869	-0.2492	-0.4480	-0.5048
	(0.1036)	(0.0863)	(0.1618)	(0.1612)
Binding Leverage$*\Delta ln(deposits)$	0.1269	0.0541	0.1524	0.1012
	(0.0595)	(0.0835)	(0.0733)	(0.0729)
Internal Capital$*\Delta ln(deposits)$	-0.0002	0.0752	-0.0002	-0.0001
	(0.0001)	(0.0424)	(0.0001)	(0.0001)
ln(consolidated assets)				-0.0033
				(0.0016)
ln(consolidated assets)$*\Delta ln(deposits)$				-0.0568
				(0.0217)
R^2	0.33	0.379	0.31	0.325
Observations	273,010	137,681	135,120	135,148

Table Notes: The table refers to a regression of annual loan growth on core deposit growth, various measures of financial constraints, and the interaction of these measures with core deposit growth. The table reports coefficients on the main effects and interactions, as well as their standard errors which have been corrected for heteroskedasticity and clustering at the bank level. The DFITS statistic from Stata was used to screen influential observations from the data in a first-stage regression.

Table 4: Monetary Policy Internal Capital Markets

	Loans		Short-term Finance	
	(1)	(2)	(1)	(2)
Intercept	-0.1144	-0.3845	-0.0833	-0.1173
	(0.1028)	(0.4970)	(0.0846)	(0.2613)
$ln(A^c) * \Delta r_t$	0.0041	0.0040	0.0018	0.0031
	(0.0009)	(0.0009)	(0.0011)	(0.0008)
$ln(A) * \Delta r_t$	-0.0060	-0.0042	-0.0019	-0.0023
	(0.0013)	(0.0017)	(0.0014)	(0.0015)
$Surplus * \Delta r_t$	-0.0364	-0.0476	-0.0427	-0.0345
	(0.0335)	(0.0367)	(0.0454)	(0.0454)
$Bind * \Delta r_t$	0.0144	0.0127	0.0023	0.0013
	(0.0039)	(0.0039)	(0.0036)	(0.0036)
$Secs * \Delta r_t$	-0.0073	-0.0104	-0.0002	0.0007
	(0.0042)	(0.0041)	(0.0034)	(0.0037)
$Cash * \Delta r_t$		0.0006		-0.0009
		(0.0000)		(0.0007)
Portfolio	No	Yes	No	Yes
Observations	0.129	0.138	0.085	0.113
R^2	130,767	130,894	130,998	131,068

Table Notes: The table refers to a regression of annual loan growth on one lag, various measures of financial constraints, the one-year change in the federal funds rate, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. The second column for each specification adds controls for loan portfolio composition and intereacts these portfolio shares with the macro variables. Each regression is estimated using the population of insured commercial banks 1986-1999. The table reports coefficients on the interactions of measures of financial constraints with the change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the bank level. The DFITS statistic from Stata was used to screen influential observations from the data in a first-stage regression.

Table 5: Monetary Policy and Internal Capital Markets

	Insured Deposits		Uninsured Deposits	
	(1)	(2)	(1)	(2)
Intercept	-0.1213	-0.4102	0.2279	-0.2240
	(0.0834)	(0.2529)	(0.0891)	(0.2531)
$ln(A^c) * \Delta r_t$	0.0028	0.0021	0.0088	0.0090
	(0.0010)	(0.0006)	(0.0015)	(0.0015)
$ln(A) * \Delta r_t$	-0.0020	0.0014	-0.0096	-0.0123
	(0.0018)	(0.0017)	(0.0022)	(0.0023)
$Surplus * \Delta r_t$	0.0384	0.0233	-0.1204	-0.0580
	(0.0507)	(0.0516)	(0.0511)	(0.0535)
$Bind * \Delta r_t$	0.0112	0.0095	0.0243	0.0226
	(0.0080)	(0.0079)	(0.0058)	(0.0059)
$Secs * \Delta r_t$	0.0059	0.0086	-0.0283	-0.0089
	(0.0041)	(0.0045)	(0.0080)	(0.0084)
$Cash * \Delta r_t$		0.0010		-0.0594
		(0.0003)		(0.0131)
Portfolio	No	Yes	No	Yes
R^2	0.054	0.066	0.086	0.087
Observations	130,864	130,966	126,543	126,899

Table Notes: The table refers to a regression of annual growth on one lag of each dependent variable, various measures of financial constraints, the one-year change in the federal funds rate, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. The second column for each specification adds controls for loan portfolio composition and intereacts these portfolio shares with the macro variables. Each regression is estimated using the population of insured commercial banks 1986-1999. The table reports coefficients on the interactions of measures of financial constraints with the change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the bank level. The DFITS statistic from Stata was used to screen influential observations from the data in a first-stage regression.

Table 6: Internal Capital Markets with More Recent Data

	Loans		Short-term Finance	
	(1)	(2)	(1)	(2)
Intercept	-0.5689	0.9332	0.1778	1.3048
	(0.1801)	(0.4236)	(0.1418)	(0.5808)
$ln(A^c) * \Delta r_t$	0.0022	0.0046	0.0051	0.0046
	(0.0016)	(0.0010)	(0.0014)	(0.0010)
$ln(A) * \Delta r_t$	-0.0044	0.0007	-0.0043	-0.0019
	(0.0021)	(0.0018)	(0.0020)	(0.0018)
$Surplus * \Delta r_t$	-0.0666	0.0219	0.0244	-0.0434
	(0.0867)	(0.0440)	(0.0920)	(0.0973)
$Bind * \Delta r_t$	0.0195	0.0209	0.0148	0.0084
	(0.0071)	(0.0062)	(0.0057)	(0.0056)
$Secs * \Delta r_t$	0.0195	0.0185	0.0034	0.0134
	(0.0085)	(0.0069)	(0.0084)	(0.0079)
$Cash * \Delta r_t$		0.0008		-0.0004
		(0.0050)		(0.0011)
$Commitments * \Delta r_t$		0.0006		0.0070
		(0.0045)		(0.0021)
$SmallLoans * \Delta r_t$		0.0402		0.0233
		(0.0058)		(0.0059)
	0.118	0.137	0.093	0.117
	61,853	61,415	61,893	61,480

Table Notes: The table refers to a regression of each dependent variable (listed by column) on one lag of the dependent variable, various measures of financial constraints, the one-year change in the federal funds rate, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. These dependent variables include (reading across) loan growth and total short-term finance growth. The second column for each dependent variable adds controls for loan portfolio composition and intereacts these portfolio shares with the macro variables. Each regression is estimated over the population of insured commercial banks 1993-1999. The table reports coefficients on the interactions of measures of financial constraints with the change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the bank level. The DFITS statistic from Stata was used to screen influential observations from the data in a first-stage regression.

Table 7: Overidentification

	Loans		Short-term Finance	
	(1)	(2)	(1)	(2)
Intercept	-0.3406	-1.1186	-0.0252	-0.4007
	(0.0464)	(0.2259)	(0.0301)	(0.1249)
$MBHC * \Delta r_t$	0.0066	0.0070	0.0067	0.0072
	(0.0015)	(0.0015)	(0.0015)	(0.0016)
$MBHC * \Delta r_t * Early$	-0.0083	-0.0078	-0.0078	-0.0077
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
$ln(assets) * \Delta r_t$	0.0021	0.0029	0.0019	0.0023
	(0.0003)	(0.0003)	(0.0003)	(0.0004)
$Surplus * \Delta r_t$	-0.0157	-0.0230	-0.0396	-0.0370
	(0.0147)	(0.0158)	(0.0175)	(0.0220)
$Bind * \Delta r_t$	-0.0077	-0.0056	-0.0083	-0.0068
	(0.0008)	(0.0008)	(0.0009)	(0.0009)
$Securities * \Delta r_t$	0.0009	-0.0002	0.0014	0.0003
	(0.0015)	(0.0015)	(0.0018)	(0.0035)
$Cash * \Delta r_t$		0.0018		0.0073
		(0.0004)		(0.0255)
Portfolio	No	Yes	No	Yes
R^2	0.123	0.139	0.111	0.123
Observations	250,957	251,322	234,309	234,569

Table Notes: The table refers to a regression of each dependent variable (listed by column) on one lag of the dependent variable, various measures of financial constraints, the one-year change in the federal funds rate, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. These dependent variables include (reading across) loan growth and total short-term finance growth. The second column for each dependent variable adds controls for loan portfolio composition and intereacts these portfolio shares with the macro variables. Each regression is estimated over the population of insured commercial banks 1976-1999. The *Early* time dummy corresponds to years before 1986, and this variable has been interacted with other variables to properly interpret the triple interaction. The table reports coefficients on the interactions of measures of financial constraints with the change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the bank level. The DFITS statistic from Stata was used to screen influential observations from the data in a first-stage regression.

Table 8: The Lending Channel in Equilibrium

	State Loan Growth		State GSP Growth	
A. 1976-1999	(1)	(2)	(1)	(2)
Intercept	0.6041	0.4826	-0.0170	-0.0638
	(0.0492)	(0.1371)	(0.0270)	(0.0763)
$\theta^{mbhc} * \Delta r_t$	0.0141	0.0091	-0.0004	-0.0034
	(0.0057)	(0.0059)	(0.0022)	(0.0022)
$\theta^{small} * \Delta r_t$	0.0091	0.0142	0.0106	0.0121
	(0.0042)	(0.0051)	(0.0027)	(0.0032)
Covariates	No	Yes	No	Yes
R^2	0.306	0.378	0.403	0.45
Observations	1122	1122	1071	1071
B. 1987-1999				
Intercept	0.9008	0.8923	0.0051	-0.1109
	(0.1273)	(0.3709)	(0.0521)	(0.1408)
$\theta^{mbhc} * \Delta r_t$	0.0302	0.0465	-0.0133	-0.0103
	(0.0187)	(0.0158)	(0.0078)	(0.0083)
$\theta^{small} * \Delta r_t$	-0.0158	-0.0042	-0.0105	-0.0110
	(0.0108)	(0.0137)	(0.0037)	(0.0038)
Covariates	No	Yes	No	Yes
R^2	0.263	0.355	0.206	0.281
Observations	612	612	612	612
C. 1993-1999				
Intercept	1.3272	0.9121	0.0818	0.2489
	(0.2680)	(0.7048)	(0.0642)	(0.1993)
$\theta^{mbhc} * \Delta r_t$	0.0879	0.0795	0.0076	0.0030
	(0.0349)	(0.0246)	(0.0110)	(0.0101)
$\theta^{small} * \Delta r_t$	0.0278	-0.0180	-0.0052	-0.0141
	(0.0199)	(0.0409)	(0.0075)	(0.0121)
Covariates	No	Yes	No	Yes
R^2	0.072	0.247	0.203	0.344
Observations	306	300	306	300

Table Notes: The table refers to a regression of each dependent variable (listed by column) on one lag of the dependent variable, various measures of state-level financial constraints, the one-year change in the federal funds rate, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. These dependent variables include (reading across) aggregate state loan growth and state gross-state product growth. State-level covariates include aggregate banking assets, liquidity, equity ratio, internal capital, and the fraction of banks with low capital ratios. In the bottom panel, covariates also include the small loan concentration of MBHC-affiliated and small banks, including the proper interactions with macro variables. The table reports coefficients on the interactions of the loan market share of MBHC-affiliated banks and small banks with the change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the state level.