New Evidence on the Lending Channel

Adam B. Ashcraft*

20 November, 2003

Abstract

Affiliation with a multi-bank holding company gives a subsidiary bank better access to external funds than otherwise similar stand-alone banks, implying that affilated banks are largely able to shield lending from a monetary contraction while stand-alone banks are forced to slow loan growth and draw down on liquid assets. In state banking markets where where stand-alone banks have more market share, the response of aggregate lending to monetary policy is stronger. On the other hand, there is little difference in the response of state output across the market share of affiliated banks, implying that the aggregate elasticity of output to bank lending is very small, if not zero. I conclude that while small firms might view bank loans as special, bank loans are not special enough for the lending channel to be an important part of how monetary policy works. JEL Codes: E50, E51. Keywords: transmisson mechanism of monetary policy, lending channel, source-of-strength.

*Banking Studies Function, Federal Reserve Bank of New York, 33 Liberty Street, New York, NY 10045. Send e-mail to Adam.Ashcraft@ny.frb.org or phone at (212) 720-1617. Sincere thanks to Daron Acemoglu, Josh Angrist, Olivier Blanchard, Ricardo Caballero, Roberto Rigobon, Jonathan Zinman, and the participants of the MIT Macro and Labor/Public Finance Seminars, as well as those at the Board of Governors, the Federal Reserve Bank of New York, INSEAD, University of Texas A&M, John Hopkins, Fisher Center for Real Estate at the Haas School of Business, and the University of Chicago GSB for their thoughtful comments. Special thanks to Mei Kok for excellent research assistance. Any remaining errors in this paper are my own, and the opinions expressed here do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System.

Bank loans might be special, but should macroeconomists care? Researchers have recently developed evidence consistent with a bank lending channel of monetary policy, where the effect of policy on bank lending is amplified by the inability of some banks to replace an outflow of insured deposits with large certificates of deposit (CDs) and federal funds. [1] Under the presumption that access to external funds is more limited for small banks, Kashyap and Stein (1995, 2000) demonstrate that small bank lending is more sensitive to monetary policy than large bank lending, and that the response of small bank lending to policy is more sensitive to holdings of liquid assets. [2] Kishan and Opiela (2000) separately develop evidence that the loan growth of highly-leveraged banks is more responsive to monetary policy than the loan growth of well-capitalized banks. Together, these studies suggest that banks might play a special role in how monetary policy affects the real economy.

While the use of panel data has given researchers the ability to isolate what appear to be shifts in loan supply across banks, the lending channel could end up being a minor part of the transmission mechanism if large liquid banks are able to pick up the slack in lending left by small illiquid banks. For example, Bernanke and Blinder (1992) document that aggregate bank lending responds to innovations in the federal funds rate but make no attempt to disentangle the effect of monetary policy on bank loan supply from the effect on loan demand. As recent research has yet to connect bank-level financial constraints with the response of aggregate bank loan supply to monetary policy, it is reasonable to question whether or not the new evidence from micro data actually adds up to the lending channel being an important part of the transmission mechanism.

Of course a relationship between the federal funds rate and aggregate bank loan supply related to imperfect access to external funds is not the end of the story. Financial constraints in banks only amplify the effect of monetary policy on real economic activity if firms are unable to replace bank loans with trade credit or other non-bank sources of finance. While such substitution might involve an increase in the cost of credit, a survey of the literature by Caballero (1997) concludes that investment is extremely insensitive to the cost of capital. Moreover, existing research has had mixed success in making a link between aggregate bank loan supply shocks to real economic activity.

For example, Driscol (2000) concludes that shifts in state bank loan supply related to state-level money demand shocks have no effect on the real economy. On the other hand, Peek and Rosengren (1997b) find evidence that capital constraints in Japanese banks related to the collapse of the Nikkei affected U.S. real estate investment in the early 1990s. Van den Heuvel (2002) concludes that bank leverage amplifies the effect of monetary policy on state output. Without evidence linking policy-induced loan supply shocks to real economic activity, it is possible that the lending channel is an unimportant part of the transmission mechanism.

This paper builds on the existing literature by first using a new source of financial constraints across banks to identify the lending channel: affiliation with multi-bank holding companies. The mispricing of deposit insurance creates well-known incentives for asset substitution, but these incentives are blunted for banks affiliated with large bank holding companies under the Federal Reserve's source-of-strength doctrine. The obligation of a parent company to assist a troubled subsidiary extends the liability of equity holders beyond their initial stake in the bank, and has the potential to mitigate underlying incentives for excessive risk-taking. [3] Building on this literature, I illustrate in this paper that stand-alone banks actually do face more severe financial constraints than affiliated banks as measured by the sensitivity of loan growth to insured deposit growth.

With reduced agency problems, affiliated banks have better access to markets for large CDs and federal funds, and thus should be better able to smooth the effect of a policy-induced outflow of insured deposits on lending. In addition, using affiliation as a source of variation in financial constraints across banks is attractive because it permits a comparison of banks that are identical except for affiliation (i.e. same size and leverage), plausibly eliminating any unobserved differences in the response of loan demand to monetary policy. When looking at the data, affiliated banks are better able to smooth outflows of insured deposits by issuing large CDs and federal funds, and consequently are better able to shield lending from a monetary contraction. In response to a one percentage point increase in the federal funds rate, the loan growth of a stand-alone bank falls by one percentage point while the loan growth of an affiliated bank is largely unaffected.

Armed with a new strategy that plausibly identifies shifts in loan supply across banks, I fill a

gap in the literature by aggregating the banking sector up to the state level, equating state lending with equilibrium lending. Using this framework, there is evidence that the loan market share of banks affiliated with multi-bank holding companies tends to mitigate the negative response of state bank loan growth to monetary policy, implying that financial constraints in banks are important enough to amplify the effect of policy on equilibrium lending. In particular, an increase in the loan market share of affiliated banks by 10 percentage points reduces the response of bank lending to a 1 percentage point monetary contraction by about 1.15 percentage points. It follows that financial constraints in banks appear important enough to affect the response of equilibrium lending to monetary policy.

On the other hand, there is no evidence to connect these aggregate loan supply shocks to real economic activity. In particular, there is no differential response of state income to monetary policy across the loan market share of affiliated banks. Instrumental variables estimates of the elasticity of state income growth to state loan growth are actually negative, although statistically not different from zero, and confidence intervals eliminate anything larger than 10 percent. Using an estimate of the response of aggregate bank loan supply to monetary policy from a structural VAR, it follows that about 25 percent of the response of aggregate bank lending but no more than 5 percent of the response of real GDP to monetary policy can be attributed to frictions related to the lending channel. I conclude that bank-level financial constraints may explain how monetary policy affects aggregate bank lending, but at the end of the day these loans are not special enough in aggregate for the lending channel to be an important part of the transmission mechanism.

I Data

In the analysis below, I use data on the population of insured commercial banks from Call Reports of Income and Condition. I rely heavily on notes created by Kashyap and Stein (2000) to follow changes in variable definitions in order to construct consistent time series. Program code is available on request. The most recent merger file from the Federal Reserve Bank of Chicago is used to identify times when banks make acquisitions that create jumps in balance sheet variables unrelated to real

economic activity. These observations are excluded from the analysis. New loan growth is measured as the percentage change in total loans. Banks are identified as part of a holding company on the basis of having a direct or regulatory holder identification number. 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.

The first two columns of Table (1) describe the main features of the data in December 1986 and 1996. The bank finance mix (line 7) is defined as the ratio of insured deposits to total deposits plus net federal funds borrowing. Internal capital (line 9) is defined in a manner similar to Houston, James, and Marcus (1997) as the sum of loan loss provisions and net income before extraordinary items relative to total loans. Starting in June 1993, I am able to use annual information on loan size as a proxy for bank customer mix. [4] Line 3 of the second column illustrates that the average commercial bank loan portfolio is dominated by loans to small businesses.

Consistent with existing research, small banks (line 15) and small bank holding companies (line 16) are defined by the 95th percentile of bank assets. The most striking fact documented in the third and fourth columns is the difference in customer mix across bank size. Small banks largely focus their loan portfolios with small businesses (line 3) and large banks having much more extensive off-balance sheet activities (lines 10 and 11), which typically involve larger firms. This empirical fact is potentially a problem for studies using variation in bank size as a source of variation in financial constraints in the presence of a balance sheet channel of monetary policy. Bernanke, Gertler, and Gilchrist (1996) document sharp differences in the response of inventories and output across firm size, attributing the difference to balance sheet effects. It can thus be quite difficult to distinguish a differential shift in loan supply across bank size (the lending channel) from a differential shift in loan demand (the balance sheet channel) across firm size when small banks concentrate their lending with small firms.

The fifth and sixth columns of Table (1) describe using 1996 data differences in bank balance sheets across another measure of financial constraints used in the literature – binding capital requirements approximated by an equity ratio of less than 6 percent. There are also significant

differences in bank characteristics across leverage, but the largest source of concern for the existing literature appears in line 20 of column 6, which demonstrates bank capital is not a clean source of variation in bank-level financial constraints. Highly-leveraged banks typically have had negative shocks to equity capital (losing about 50 basis points) while well-capitalized banks have had positive shocks to equity (gaining about 40 basis points). As this phenomenon is likely driven by a relative deterioration in loan quality, it seems reasonable to suspect that there are differences in firm creditworthiness across bank leverage. In the presence of a balance sheet channel, one would naturally expect differences in the response of investment to monetary policy across borrower creditworthiness. It follows that it may be hard to distinguish a differential shift in loan supply across bank leverage (the lending channel) from a differential shift in loan demand across firm creditworthiness (the balance sheet channel) when low capital banks concentrate their lending with less creditworthy firms.

Ideally, one would like to hold constant bank size and leverage and use another source of variation in financial constraints unrelated to how loan demand responds to monetary policy. The seventh and eighth columns illustrate that affiliation with a multi-bank holding company might be a promising strategy. Along most dimensions, unconditional differences in bank characteristics are smaller across holding company affiliation than across bank size or leverage. While large banks are on average 45 times larger than small banks in line 1 of columns 3 and 4, banks affiliated with multi-bank holding companies are on average only three times larger in line 1 of columns 7 and 8. Note that while 90 percent of banks affiliated with multi-bank holding companies are small in line 15 of column 8 (compared to 96.5 percent for unaffiliated banks in column 7), only 56.4 are effectively small when using the size of their affiliated holding company in line 16. More important is the large narrowing in customer mix across holding company affiliation, with the difference in line 3 going from 48 between columns 3 and 4 to 8 percentage points between columns 7 and 8. Also note the narrowing of the gap in off-balance sheet behavior in lines 10 and 11, and the narrowing of differences in the lagged change in equity relative to a strategy using leverage. The last two columns of the table illustrate that differences across affiliation are even smaller for the

subset of small banks, which lends plausibility to the idea that conditional on bank variables like size and leverage, affiliation with a multi-bank holding company is exogenous to the response of loan demand to monetary policy. Overall, the strategy of exploiting affiliation with large holding companies looks promising relative to existing research that uses either bank size or leverage.

Following Bernanke and Blinder (1992), I utilize the federal funds rate as a measure of monetary policy. That the federal funds rate might be a good indicator of monetary policy is illustrated in Figure (1) 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 are correlated with a reduction in share of insured deposits in short-term finance, consistent with banks relying more on uninsured debt. As the lending channel operates through changes in the mix of insured deposits in bank liabilities, the federal funds rate looks like exactly the right measure of monetary policy to use in the analysis below.

II New evidence using bank-level data.

This section contains the core results of the paper. I first present evidence that a 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. Finally, I conduct several robustness exercises to ensure this result is not driven by omitted variables or driven by the annual frequency of data employed in the analysis.

A Affiliation and the sensitivity of investment to cash flow.

Fazari, Hubbard, and Petersen (1988) developed the standard strategy for identifying the presence of financial constraints across firms: document differences in the sensitivity of investment to cash flow across a priori measures of financial constraints. In the absence of increasing marginal costs for external funds, firms should be indifferent between using internal funds and issuing debt to finance new investment. When agency problems imply access to debt markets is expensive, however,

actual investment will be sensitive to the availability of funds free of agency problems. For most firms, so-called internal funds are limited to retained earnings, but for banks the under-pricing of deposit insurance implies that a better measure of internal funds is growth rate of insured deposits. Jayaratne and Morgan (2000) employed this approach to identify financial constraints across banks using differences in the sensitivity of loan growth to insured deposit growth, but the authors focused on measures of financial constraints other than affiliation with a multi-bank holding company. Equation (1) describes the empirical model actually estimated:

$$\Delta ln(loans)_t = \alpha_0 + \alpha_1 \Delta ln(deposits)_t + \beta X_{t-1} + \gamma X_{t-1} \Delta ln(deposits)_t + \sum_t \eta_t \tag{1}$$

This is a regression of annual loan growth on insured deposit growth, lagged bank characteristics X_{t-1}, the interaction of these characteristics with insured deposit growth, and a full set of time effects η_t. The characteristics include the ratio of securities to assets, internal capital generation to assets, capital surplus to assets, a dummy variable for binding leverage requirements, total assets, and a dummy variable for affiliation with a multi-bank holding company. The presence of interactions of core deposit growth with characteristics other than holding company affiliation reduces the likelihood of contamination by unobserved variables that are correlated with holding company affiliation. [5]

The traditional econometric concern in a simple regression of investment on cash flow is that the latter confounds the availability of internal funds with the profitability of future investment opportunities. I address this problem by focusing on the differences in the sensitivity of investment to cash flow across affiliation with a bank holding company. Another potential problem is that strong insured deposit growth could signal strong loan demand, implying that the greater sensitivity of small banks to insured deposit growth could reflect underlying differences in the response of bank customers to economic conditions. If bank holding company affiliation eliminates differences in bank loan demand conditional on other bank characteristics, however, this will not be an issue.

Coefficients and standard errors from OLS estimation of equation (1), are reported in the first column of Table (2). Standard errors have been corrected for heteroskedasticity and clustering at

the bank level. The first column of the table demonstrates in line 10 that the loan growth of banks affiliated with multi-bank holding companies is less sensitive to core deposit growth. The coefficient on this interaction implies being affiliated with a holding company reduces the sensitivity of lending to insured deposits on average by 17.7 percent. Moreover, measures of leverage, bank size, and cash flow in lines 13, 9, and 14, respectively, appear to have the expected signs. In order to gauge how large the benefits of affiliation might be economically, first note that the difference in the sensitivity of loan growth to insured deposit growth across affiliation is similar in magnitude to differences across binding capital standards from row 13. In other words, the benefit from affiliation with a multi-bank holding company in terms of access to external funds is about the same as the benefit of adequate capitalization. Further note in line 9 that the effect of affiliation is about 2.7 times the effect of log assets in reducing the sensitivity of loan growth to deposit growth. As the average stand-alone bank had $167 million in assets during 1996, these coefficients imply that affiliation permits this relatively small bank to have access to the federal funds and large CD market of a bank with $2.5 billion in assets. By one reasonable measure, affiliation significantly reduces the financial constraints otherwise faced by banks.

B The differential response of lending to monetary policy.

As the response of affilated bank lending is less sensitive to the availability of internal funds, it seems natural to look for a differential response of lending to changes in the federal funds rate across affiliation. The actual model estimated is displayed in Equation (2):

$$\Delta ln(loans)_t = \alpha_0 + \alpha_1 \Delta ln(loans)_{t-1} + \beta_1 M_t + \beta_2 X_{t-1} + \beta_3 M_t X_{t-1} + \sum_t \eta_t \tag{2}$$

Annual loan growth is regressed against a set of macro variables M_t, a set of lagged bank characteristics X_{t-1}, interactions of the macro and bank characteristics, and a full set of time effects η_t. The presence of bank variables other than holding company affiliation interacted with the macro variables implies 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, X_{t-1} includes the log of total bank assets, the liquidity ratio, the equity ratio, information about the bank loan portfolio composition, and internal capital generation. The interaction of each measure with aggregate output growth is meant to capture differential changes in loan demand across banks in response to any change in output.

An immediate question must be why use annual data to study monetary policy? Kashyap and Stein (2000) use a two-step procedure on quarterly data where they first run a sequence of regressions by cross-section and then use the estimated coefficients in a time-series regression. Newey and McFadden (1994) point out that standard errors from the second stage of a two-step estimator are generally inconsistent. Only when the consistency of the first-stage does not affect the consistency of the second stage will the estimated second-stage standard errors be appropriate. [6] If one combines both steps into one using a generalized difference-in-difference estimation strategy, however, this issue can be entirely avoided. The sacrifice here practically is that one must use a lower frequency of data. As this one-step approach requires that all variables and their interactions with macro variables be present in the regression, it is simply not practical to use quarterly data. [7] While reducing the number of covariates makes the use of quarterly data feasible, it reduces the ability to control for differences in the response of loan demand to monetary policy across banks. As I am most concerned about identification, I will start with the annual data to maximize controls. I will demonstrate robustness of a stripped-down version of the baseline results to data frequency, and will be able to use quarterly data when aggregating up to the state level.

Table (3) reports coefficients and standard errors on the interaction terms β_3 from OLS estimation of Equation (2). The first column demonstrates in line 2 that being affiliated with a multi-bank holding company reduces the response of loan growth to a change in the federal funds rate by 0.42 percentage points when comparing banks of equal size, capital position, liquidity, and internal capital. In the context of a 1 percentage point increase in the federal funds rate, the coefficient implies that affiliation mitigates the negative effect that monetary policy has on bank loan growth by 0.42

percentage points. A natural question is how much of the response of bank lending to monetary policy does this source of variation in financial constraints across banks explain? One answer could be found on the estimated main effect β_1 from Equation (2), but this is absorbed by the time effects in the first column. Before simply dropping these time effects, however, note that in the presence of interactive terms $M_t * X_{t-1}$, the main effect is implicitly the effect of monetary policy on bank lending for banks that have $X_{t-1} = 0$. This of course implies that dropping the time effects and reporting the main effect for the change in the funds rate is not the right thing to do.

One approach is to avoid the problem by estimating Equation (2) without either time effects or the interactive terms to estimate the average effect of monetary policy on loan growth, which is done in column (2) of the table. Line 8 illustrates an immediate challenge, indicating that one percentage point increase in the federal funds rate actually increases bank lending by 0.68 percentage points. This result is not created by the low frequency of the data, and is actually stronger with the quarterly data. The weak measured effect of monetary policy on bank lending is driven by the weak response of bank lending to the monetary expansion of the early 1990s, which in turn was probably related to the introduction of risk-based capital requirements in 1990. A large empirical literature surveyed by Sharpe (1995) establishes a link between tougher bank capital requirements and the capital crunch that existed during the early 1990s. In order to control for the effect that the Basle Accord might have had on bank lending, I add a dummy for the time period 1990-1993 and its interaction with macro variables M_t, implicitly identifying the effect of monetary policy on lending using data from the other years. The main effect in line 8 of column (3) now indicates that a 1 percentage point increase in the federal funds rate reduces bank loan growth by 0.45 percentage points. With this number in mind, it follows that the differential response of bank lending to monetary policy across affiliation from line 2 of column (1) is approximately equal to the average response of lending to monetary policy. By this measure, the estimated effect of affiliation is strong enough so that lending is unaffected by the monetary contraction.

An alternative approach is to use the main effect for the federal funds rate in order to measure the effect of monetary policy on the loan-growth of stand-alone banks. This is easily accomplished

by dropping all interactive terms related to financial constraints other than the three interactions of affiliation with macro variables. I also de-mean the loan portfolio controls and include their interactions with macro variables, so implicitly the main effect for the federal funds rate is estimated at the average bank loan portfolio. The coefficient in line 8 of column (4) now indicates that a 1 percentage point increase in the federal funds rate reduces stand-alone bank lending by 0.76 percentage points. More interestingly, the coefficient in line 2 suggests that affiliated banks only reduce lending by 0.20 (=0.56-0.76) percentage points, which is not statistically different from zero, and again implies monetary policy has little if any effect on affiliated bank lending.

A final approach is to only include covariates in X_{t-1} that are decreasing in the severity of financial constraints. In this formulation, dropping the time effects implies that the main effect for the federal funds rate measures the effect of monetary policy on bank lending for a very small stand-alone bank with an equity ratio below 6 percent and no liquid assets or internal capital. Since the evidence above suggested that bank size and leverage are correlated with borrower creditworthiness, it is not possible to interpret this particular main effect as a loan supply shock. One might alternatively interpret this as the total effect of financial constraints (through both the lending and balance sheet channels) on the response of lending to monetary policy. In this specification, I drop the dummy for binding capital requirements and its interactions with macro variables since they are increasing in the severity of financial constraints, and also de-mean the loan controls and include interactions as above. The coefficient on the federal funds rate in line 8 of column (5) indicates that the measured benefit of affiliation in line 2 is equal to about one-fifth of the response of lending to policy of the most financially constrained banks. The implication here is that financial constraints in banks related to affiliation are an important part of how financial constraints in general affect the response of bank lending to monetary policy.

Overall, the evidence presented here suggests that stand-alone bank lending is sensitive to changes in the federal funds rate while affiliated bank lending is largely unaffected by monetary policy. Before assessing whether or not this aggregates up into a lending channel of monetary policy, there are some potential threats to identification. First, any macro shock that had a differ-

ential effect on bank lending across affiliation with a multi-bank holding company would affect the measured benefit of affiliation to the extent that this shock was correlated with monetary policy. Second, the presence of an unobserved dimension of bank customer mix that is correlated with the response of loan demand to monetary policy and with affiliation might imply the analysis above confuses shocks to loan demand for shocks to loan supply. Each of these potential concerns is addressed in turn.

C Robustness to the implementation of the Basle Accord.

The evidence above suggested that controlling for the implementation of the Basle Accord was important in measuring the average effect that monetary policy had on bank loan growth. One potential problem is that introduction of risk-based capital regulation likely had a differential effect across affiliation with a multi-bank holding company. In particular, a bank affiliated with a multi-bank holding company has cheaper access to capital than a stand-alone bank. In addition to the parent company operating as a source-of-strength and thus reducing the cost of issuing new capital for the affiliated bank, the operation of internal capital markets could reallocate excess capital from capital-rich to capital-constrained subsidiaries. During the monetary expansion of the early 1990s, a lending channel measured across affiliation would imply that the loan growth of stand-alone banks would respond more than that of affiliated banks since the inflow of insured deposits would have a larger effect on stand-alone bank lending. When stand-alone banks are also hit harder by tougher capital requirements, then loan growth would actually be slowed by the need to raise more capital, and the measured effect of affiliation on the response of bank lending to monetary policy is biased towards zero.

I control for any differential effect that the Basle Accord might have had on bank lending by interacting the dummy for the time period 1990-1993 with X_{t-1} and replicate the specifications from columns (4) and (5) of Table 3. In column (6), I use stand-alone banks to measure the main effect of the federal funds rate on bank loans, and the coefficient in line 2 indicates that the effect of affiliation is now 0.96 percentage points. Relative to the estimated main effect in line 8,

this coefficient again implies that affiliated bank lending is essentially unaffected by the monetary contraction. In column (7), I use the most financially constrained banks to measure the main effect as in column (5). The measured effect of affiliation in line 2 is 0.88 percentage points, almost one-half of the effect of monetary policy on the loan growth of the most constrained banks.

Overall the evidence suggests that controlling for the impact of the Accord has an important effect on the measured benefits of affiliation, but the main message does not seem to change. While the measured effect of monetary policy on stand-alone bank lending is larger than it was in the analysis without controls for the Accord, it is still approximately equal to the differential effect of policy across affiliation, implying that affiliated banks are able to shield loan growth from the effects of monetary policy.

D Robustness to better controls for bank customer mix.

Starting in 1993, it is possible to improve upon the controls for bank customer mix, as data concerning the small loan concentration of the loan portfolio are available. One potential problem is that there might be a negative correlation between affiliation and small business loan concentration. There has been at least concern raised in the literature that credit to small businesses is being cut back as large bank holding companies expand into new markets and buy smaller banks. For example, see Peek and Rosengren (1997a).

As a way to better use these new controls, I re-estimate Equation (2) over 1993-99, adding small loan concentration and the ratio of loan commitments to total loans to X_{t-1}. The results displayed in Table (4) are consistent with those over the longer sample without controls. The point estimate of 0.98 percent in line 2 of the first column is similar in magnitude to the estimate of the effect of affiliation over the whole sample when controlling for the effect of the Basle Accord. Since there was no change in capital requirements over this later time period, this suggests that controlling for the differential effect of the Accord might be the appropriate thing to do. Even though small loan concentration has an important effect on the response of bank lending to monetary policy (with sign opposite to that predicted by the balance sheet channel), these variables do not seem to

explain why the response of loan growth to monetary policy is weaker across affiliation, ruling out an important threat to identification.

In order to gauge the economic importance of affiliation over the shorter sample, I measure the average effect of monetary policy on bank lending in the second column. The coefficient in line 10 indicates that a 1 percentage point increase in the federal funds rate reduces loan growth by 0.41 percentage points, which is not much different from the full sample after controlling for the effect of the Accord, and is evidence suggesting that controlling for the impact of the Accord is appropriate. [8] In column (3), I measure the effect of policy on stand-alone bank lending, where a 1 percentage point increase in the funds rate reduces unaffiliated bank lending by 0.89 percentage points in line 10. The coefficient of 0.88 percentage points in line 2 suggests that affiliated banks are unaffected by monetary policy. The measured effect of monetary policy on the loan growth of the most constrained banks increases from almost 2 percent in the previous table to 4.75 percent in line 10 of column (4).

E Robustness to the source of strength doctrine.

While small business loan concentration does not explain the differential response of bank lending across affiliation, it is of course possible that there is some other unobserved difference in loan demand that is driving these results. The only way to convincingly rule out such an omitted variable is to take another difference.

Recall that the mechanism through which affiliation with a multi-bank holding company arguably mitigates financial constraints is assistance from a parent company during financial distress. The value of affiliation should increase with the consolidated assets of the holding company excluding the subsidiary in question as well as the correlation in cash flows across other subsidiary banks. It seems reasonable to expect that banks affiliated with smaller undiversified holding companies to respond much like stand-alone banks. Consequently, one might expect affiliation with a holding company to be less important when bank holding companies were much smaller and faced restrictions on branching across states. In fact, early holding companies were largely vehicles used to

circumvent intra-state branching restrictions and had little assets of value at the parent. Moreover, these affiliated banks were also likely to have very correlated loan portfolios because of inter-state branching restrictions, which were in place until the mid-1980s. As holding companies finally became able to acquire banks across state lines and expand their non-bank activities the correlation between subsidiary cash flows fell, increasing the value of affiliation. [9]

More significant than changes in the banking industry was a change attitude by the regulators about the responsibilities of bank holding companies. In February 1987, the Federal Reserve Board charged Hawkeye Bankcorp with unsafe banking practices for not injecting capital into a failing subsidiary bank. This action signaled a significant change in policy, as it was the first time that the Board had taken such an action against a bank holding company. Two months later, the Board issued a formal policy statement indicating a failure by a parent holding company to act as a source of strength to a troubled subsidiary when resources were available would be considered to be an unsafe and unsound banking practice. Ashcraft (2003) documents evidence that since the announcement of the source-of-strengh doctrine, affiliated banks are safer than stand-alone banks. In particular, affiliation with a multi-bank holding company reduces the probability of future financial distress and distressed affiliated banks are more likely to receive capital injections and recover more quickly than stand-alone banks. More interestingly, the benefits of affiliation only appears after the formal announcement of policy by the Federal Reserve. A natural way to falsify the results above is to demonstrate that affiliation did not reduce the sensitivity of lending to insured deposits nor did it affect the response of lending to monetary policy before the announcement of a formal source-of-strength doctrine.

In order to investigate whether or not holding company affiliation was less important in the early years, I re-examine differences in the sensitivity of loan growth to insured deposit growth across affiliation by time period. The second column of Table (2) reports the results of estimating Equation (1) over the early time period 1976-1986. While the coefficient over the full period on the interaction of insured deposit growth with multi-bank holding company affiliation is still negative in line 10, it is much smaller and no longer statistically significant.

Since there is no evidence that affiliation reduces financial constraints before 1986, the response of affiliated bank lending to monetary policy should not be different from stand-alone banks in this early period. If differences across affiliation were to persist in the early period, one might be concerned that they simply captured unobserved differences in the customer mix (beyond firm size and fraction of commitments) across holding company affiliation. I test this hypothesis by re-estimating Equation (2) and breaking out the coefficient on the interaction of holding company affiliation with monetary policy across the two time periods, inserting the proper time period main effects and interactions.

Results are displayed in column (5) of Table (4). The coefficient of 0.70 in line 2 measures the effect of affiliation in mitigating the negative response of bank lending to monetary policy since 1986, and is consistent with the estimates above. On the other hand, the coefficient in line 11 of -0.78 is nearly the opposite of the later benefits of affiliation, and implies that before 1986 affiliation with a bank holding company had no effect on the response of bank lending to monetary policy. Since there is no differential response of lending to monetary policy across affiliation in the years before the source-of-strength doctrine really had any real bite, it seems reasonable to interpret the differential response of lending above as a loan supply shock related to differential access to external funds.[10]

F Robustness to the frequency of data.

One final concern might be that these results are somehow an artifact of the low frequency of the data used in the analysis. To address this issue, I re-estimate equation (2) using quarterly data with a few small changes. First, I shorten the list of covariates to include only the ratio of equity to assets, securities to assets, small loans to surveyed loans when possible, consumer and industrial loans to total loans, real estate loans to total loans, the log of total assets, and a dummy for being affiliated with a multi-bank holding company. Results are illustrated in Table (5), which reports the coefficients on interactions of affiliation with lags of the change in federal funds rate. The first column refers to the sample 1986-1999 while the second column refers to 1993-1999. Similar to

Kashyap and Stein (2000), each column also reports the sum of coefficients in line 5 and reports the p-value for a hypothesis test that this sum is different from zero in line 6. In both the full and recent samples, results are similar to those observed above at an annual frequency.

III New evidence using aggregated data.

Having identified a differential response of loan supply to changes in the federal funds rate across banks, the next step is to identify whether or these add up 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 large CDs and federal funds in order to pick up the slack in lending created by other banks so that the observed difference in bank loan growth across access to internal capital markets corresponds to no change in aggregate lending. On the other hand, it is not clear that changes in monetary policy do not have qualitatively similar but quantitatively smaller effects on other types of banks. In particular, 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.

A The state level evidence.

In order to assess whether or not the differential response of bank lending to monetary policy across affiliation actually corresponds 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 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. [11] As with the micro data 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. [12] The actual equation estimated is described in Equation (3):

$$\Delta ln(Y)_{st} = \alpha_0 + \sum_{j=1}^{4} \alpha_j \Delta ln(Y)_{st-j} + \sum_{j=1}^{4} \beta_j M_{t-j} + \gamma_0 X_t + \sum_{j=1}^{4} \gamma_j M_{t-j} X_t \tag{3}$$

The dependent variable $\Delta ln(Y)_{st}$ is alternatively aggregate state loan growth in the first two columns and the state income growth in the final two columns. The macro variables are identical to above, and the state banking characteristics are those used above aggregated to the state level. Since the data have been aggregated, the size of the data set is no longer an issue and quarterly data is employed.

Results are displayed in Table (6), which reports in lines 1 and 7 the sum of coefficients on the interaction of changes in monetary policy with the loan market share of affiliated banks. P-values reported in lines 4 and 10 are for the hypothesis that the sum is no different from zero. Panel A is estimated over 1986-1999 and Panel B is estimated over 1993-1999. The first column regresses state loan growth on four lags of loan growth, main effects for changes in the federal 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 regression also includes state-level aggregates of bank capitalization, asset size, and liquidity, each also interacted with macro variables.

The sum of coefficients in line 1 of the first column indicates that the response of state loan growth to a change in the federal funds rate is actually mitigated by the loan market share of affiliated banks. In the context of a 1 percentage point increase in the federal funds rate, an increase in the loan market share of MBHCs by 10 percentage points mitigates the negative response of state loan growth to monetary policy by 1.15 percentage points. Results in line 7 of Panel B are quite similar, where controls for small loan concentration of affiliated banks and small banks are also

included with the proper interactions. Overall, there is evidence suggesting differential shifts in aggregate loan supply across a measure of state-level financial constraints.

The lending channel is not a part of the transmission mechanism, however, unless there is a differential effect of policy on real variables. This link is investigated in column (2), which reports the effect that the loan market share of affiliated banks has on the response of state income growth to monetary policy. Over the full sample in line 1, the measured effect of affiliated loan market share is actually negative, although statistically insignificant. While the estimated coefficient is positive in line 7, it is small, more than an order of magnitude smaller than the effect on loan growth, and statistically not different from zero.

The third column constructs instrumental variables estimates of the elasticity of state income growth to state loan growth. Interactions of the loan market share of affiliated banks with four lagged changes in the federal funds rate are used as instruments in a regression of state income growth on four lags, state loan growth, and the same controls as in the previous two columns. Instrumental variables estimates are approximately -9 percent in lines 2 and 8, but not statistically different from zero. A conservative confidence interval would rule out an elasticity of income growth to loan growth that was higher than 10 percent, and in this sense the result is broadly consistent with Driscoll (2000).

B How big is the lending channel?

The estimated elasticity of real output to loan supply can be used to gauge the importance of the lending channel in the transmission mechanism of monetary policy only if we can (a) measure how much output responds to monetary policy and (b) measure how much loan supply responds to monetary policy. In order to answer these questions, I use a structural VAR with three variables (loans, real GDP, and the federal funds rate) and follow the approach of Bernanke and Blinder (1992). In order to identify the effect of monetary policy, I employ the usual ordering assumption that the funds rate has no immediate impact on loans or real GDP. The structural VAR uses quarterly data 1954-2002:III, and four lags of each variable are included in each equation. In order

to ensure a stationary system, I use the percentage change in loans $\Delta ln(L_t)$ and real GDP $\Delta ln(Y_t)$ as well as the change in the federal funds rate Δi_t during estimation. The reduced-form that is actually estimated by OLS is displayed in equation (4).

$$\begin{pmatrix} \Delta ln(L_t) \\ \Delta ln(Y_t) \\ \Delta i_t \end{pmatrix} = \sum_{j=1}^{4} \begin{bmatrix} \pi_j^{ll} & \pi_j^{ly} & \pi_j^{li} \\ \pi_j^{yl} & \pi_j^{yy} & \pi_j^{yi} \\ \pi_j^{il} & \pi_j^{iy} & \pi_j^{ii} \end{bmatrix} \begin{pmatrix} \Delta ln(L_{t-j}) \\ \Delta ln(Y_{t-j}) \\ \Delta i_{t-j} \end{pmatrix} \tag{4}$$

Figure (2) illustrates the estimated response of commercial bank loans and real GDP to an innovation in the federal funds rate. A 1 percentage point increase in the federal funds rate leads to a decrease in real GDP of 0.49 percentage points and bank loans of 0.84 percentage points after one year. Unfortunately, the simple structural VAR impulse response does not indicate how much of the decline in lending is driven by a decline in loan supply related to the lending channel versus a decline loan demand due to higher interest rates or changes in balance sheet condition. With a little more structure, however, it is possible to decompose this impulse response in order to say something meaningful about the size of the lending channel.

In particular, there are two important facts hidden in the VAR coefficients. First, most of the decline in lending is driven not by the direct response of lending to policy (π_j^{li}) but by the indirect response through output (π_j^{ly}). As it is unlikely that the response of bank lending to output has anything to do with the lending channel, one might be able to construct an upper bound on the response of bank loan supply to monetary policy by shutting this mechanism down.[13] Second, almost all of the response of real GDP to monetary policy is through the direct effect of the federal funds rate (π_j^{yi}), as output does not respond very much to aggregate bank lending (π_j^{yl}). The weak direct response of aggregate loan supply to monetary policy and weak response of real GDP to lending are not good news for the lending channel playing an important role in the transmission mechanism.

In order to measure the response of loan supply to monetary policy, the impulse response of loans and real GDP is constructed under the restrictions that (a) real GDP has no direct effect on

loans ($\pi_j^{ly} = 0$) and (b) the federal funds rate has no direct effect on real GDP ($\pi_i^{yi} = 0$). What is left is displayed in Figure (3), and represents the direct effect of monetary policy on bank lending plus the effect that bank lending has on output. I emphasize that the VAR is not re-estimated under these restrictions, and that this is a back-of-the-envelope decomposition of the impulse response into one part that is related to the lending channel and another part that is not related to the lending channel.

In response to a one percentage point increase in the federal funds rate, bank loan supply falls by 20 basis points after one year, equal to about one-fourth of the total response of lending to monetary policy. Using the upper bound of 10 percent on the estimate of the elasticity of output of to bank loans, it follows that financial constraints in banks amplify the effect of monetary policy on output by only 2 basis points after one year, equal to less than five percent of the response of real output to monetary policy.[14] I conclude that the lending channel is an insignificant part of the transmission mechanism of monetary policy, largely because of the low measured response of real output to aggregate bank lending.

IV Conclusions

Financial constraints in banks help to explain how banks respond to monetary policy, but they do not seem to explain why real variables are so sensitive to small and temporary changes in short-term interest rates. The literature surveyed by James and Smith (2000) generally supports the idea that that bank loans are special, but the evidence presented here suggests that they are not special enough to play an independent role in the transmission mechanism of monetary policy.

Future research should explore why the elasticity of real output to loan supply is so small. In particular, does this simply reflect the insensitivity of investment to the cost of capital, and if so what are the other sources of funds that firms use to shield investment from a contraction in loan supply? On the other hand, perhaps small firms are unable to shield the effect of monetary policy on output, but large firms are able to step in and fill the gap.

This result has important practical implications for policymakers. In particular, proposed revi-

sions to the Basle Accord have been slowed down by suggestions that making capital requirements more risk-sensitive will make capital requirements tougher during a downturn. When bank loans are special enough, a credit crunch induced by tougher capital requirements might amplify the effect of the downturn and undermine the effectiveness of expansionary monetary policy. The evidence developed here implies these effects are likely to be very small and unworthy of concern.

References

[1] Ashcraft, Adam (2003), "Are Bank Holding Companies a Source of Strength to their Subsidiaries? New Evidence on the Operation of Internal Capital Markets," unpublished working paper.

[2] Bernanke, Ben and Blinder, Alan (1992), "The Federal Funds Rate and the Channels of Monetary Transmission," The American Economic Review, Volume 82, Issue 4, pp. 901-921.

[3] Bernanke, Ben, Gertler, Mark, and Gilchrist, Simon (1996), "The Financial Accelerator and the Flight to Quality," The Review of Economics and Statistics, Volume LXXVIII, Issue 1, pp. 1-15.

[4] Bernanke, Ben and Lown, Cara (1991), "The Credit Crunch," Brookings Papers on Economic Activity, Volume 0, Issue 2, pp. 204-39.

[5] Caballero, Ricardo (1997), "Aggregate Investment," Handbook of Macroeconomics, Volume 1B, Part 4, Chapter 12. Edited by John Taylor and Michael Woodford.

[6] Driscoll, John (2000), "Does Bank Lending Affect Output? Evidence from US States," unpublished working paper.

[7] Fazzari, Steven, Hubbard, Glen, and Petersen, Bruce (1988), "Financing Constraints and Corporate Investment," Brookings Papers on Economic Activity, pp. 141-195.

[8] Furfine, Craig (1999), "The Pricing of Bank Lending and Borrowing: Evidence from the Federal Funds Market," BIS Working Paper Number 62.

[9] Grossman, Richard S (2001), "Double Liability and Bank Risk Taking," Journal of Money, Credit, and Banking, Volume 33, Issue 2, Part 1, pp. 143-159.

[10] Hannan, Timothy H., and Hanweck, Gerald A. (1988), "Bank Insolvency Risk and the Market for Large Certificates of Deposit," Journal of Money, Credit and Banking, Volume 20, Number 2, pp. 203-211.

[11] Houston, Joel, James, Christopher, and Marcus, David (1997), "Capital Market Frictions and the Role of Internal Capital Markets in Banking," Journal of Financial Economics, Volume 46, pp. 135-164.

[12] James, Christopher and Smith, David (2000), "Are Banks Still Special? New Evidence on Their Role in the Corporate Capital-Raising Process, Journal of Applied Corporate Finance, Volume 13, Number 1, pp. 52-63.

[13] Jayaratne, Jith and Morgan, Don (2000), "Capital Market Frictions and Deposit Constraints at Banks," Journal of Money, Credit, and Banking, Volume 32, Issue 1, pp. 74-92.

[14] Jayaratne, Jith and Strahan, Philip (1996), "The Finance-Growth Nexus: Evidence from Bank Branch Deregulation," Quarterly Journal of Economics, pp.639-669.

[15] Kashyap, Anil and Stein, Jeremy (1995), "The Impact of Monetary Policy on Bank Balance Sheets," Carnegie-Rochester Conference Series on Public Policy, Volume 42, pp. 151-195.

[16] Kashyap, Anil and Stein, Jeremy (2000), "What Do One Million Observations on Banks Have to Say About the Transmission of Monetary Policy," American Economic Review, Volume 90, Number 3, pp. 407-428.

[17] Keeley, Michael C (1990), "Deposit Insurance, Risk, and Market Power in Banking," American Economic Review, Volume 80, Issue 5, pp. 1183-1200.

[18] Kishan, Ruby and Opiela, Timothy (2000), "Bank Size, Bank Capital, and the Bank Lending Channel," Journal of Money, Credit, and Banking, Volume 32, Issue 1, pp. 121-141.

[19] Merton, R. C. (1977): "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees," Journal of Banking and Finance, Volume 1, pp. 3-11.

[20] Newey, Whitney and McFadden, Daniel (1994), "Large Sample Estimation and Hypothesis Testing," Handbook of Econometrics, Volume IV. Edited by R.F. Engle and D.L. McFadden.

[21] Peek, Joe and Rosengren, Eric (1997a), "Bank Consolidation and Small Business Lending: It's Not Just Bank Size that Matters," Working Paper, Federal Reserve Bank of Boston.

[22] Peek, J. and Rosengren, E. (1997b): "The International Transmission of Financial Shocks: The Case of Japan," American Economic Review, 87, pp. 495-505.

[23] Sharpe, S. A. (1995): "Bank Capitalization, Regulation, and the Credit Crunch: A Critical Review of the Research Findings." Working Paper 95-20, Finance and Economics Discussion Series.

[24] Van den Heuvel (2002): "Banking Conditions and the Effects of Monetary Policy: Evidence from U.S. States," unpublished working paper.

[25] Welsch R E and E Kuh (1977), "Technical Report 923-77: Linear Regression Diagnostics," Cambridge, MA: Sloan School of Management, Massachusetts Institute of Technology.

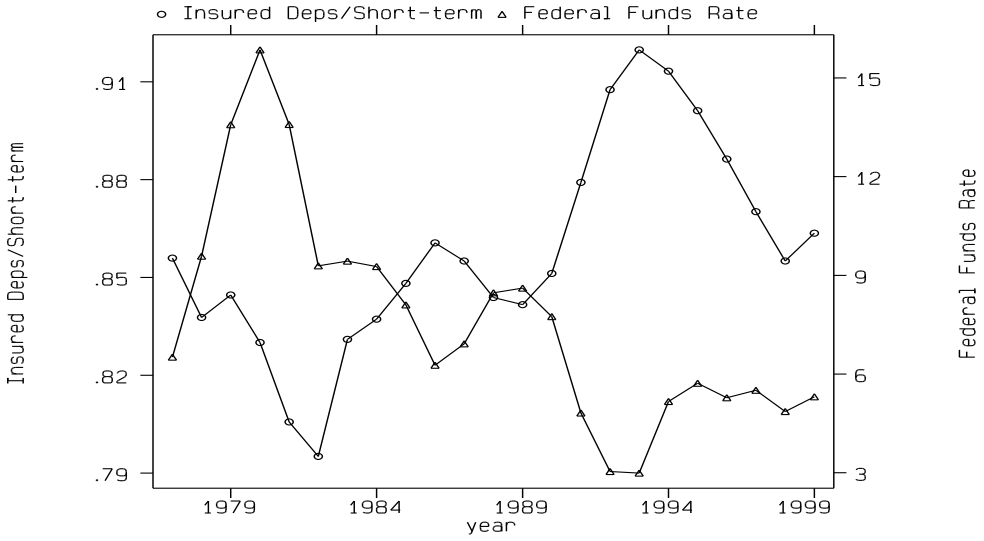

Figure 1: Bank Short-term Finance Mix Versus the Funds Rate

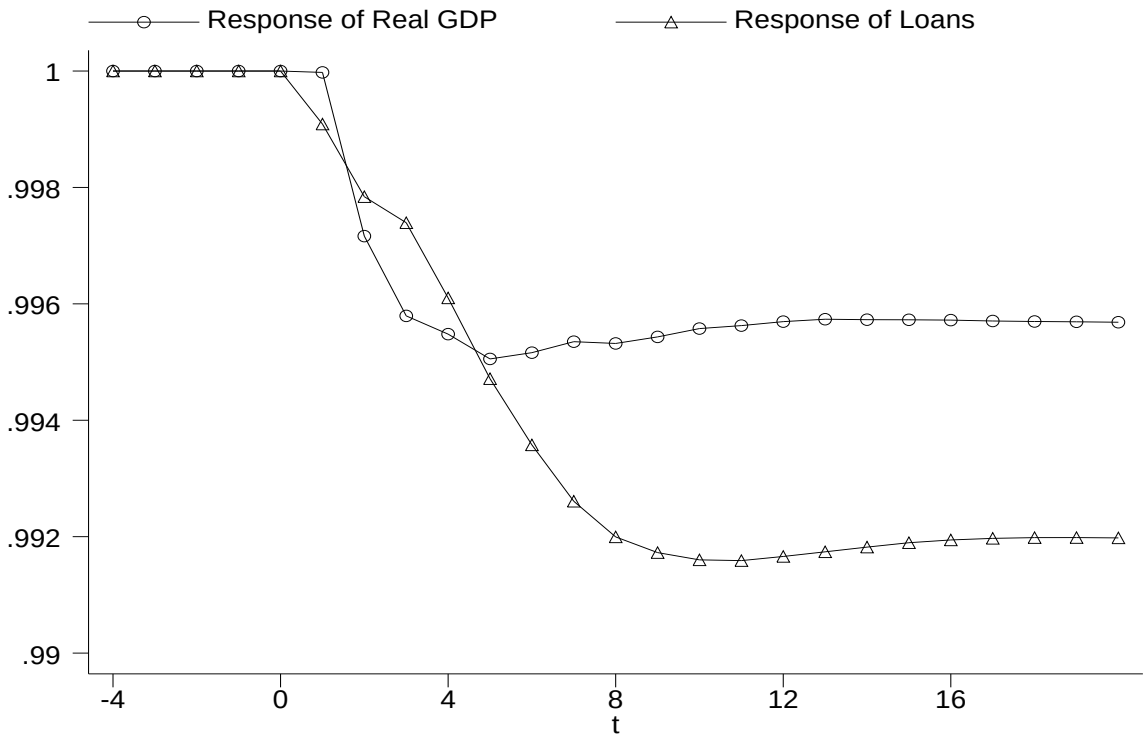

Figure 2: Response of Commercial Bank Loans and Real GDP to 1 Percentage Point Increase in the Federal Funds Rate

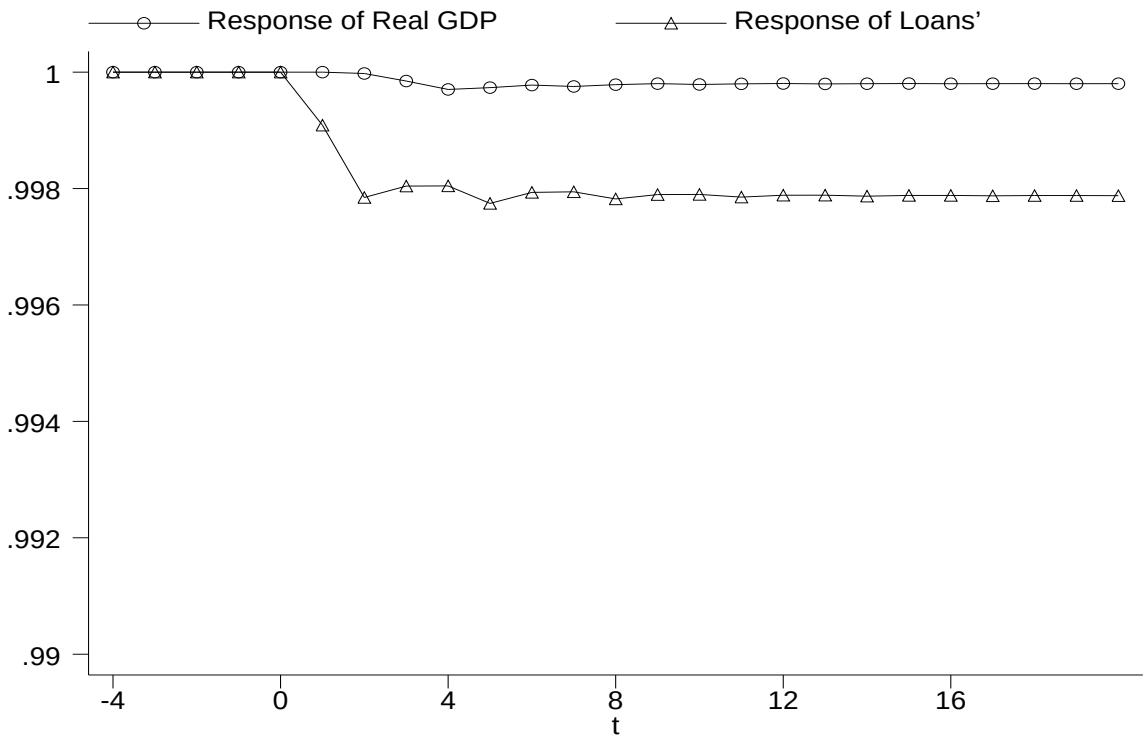

Figure 3: Response of Commercial Bank Loans and Real GDP to 1 Percentage Point Increase in the Federal Funds Rate Attributed to the Lending Channel

Notes

[1]Furfine (1999) describes evidence that the cost of overnight federal funds borrowing depends on borrower size, leverage, and loan size. Hannan and Hanweck (1988) find similar evidence in the market for large CDs.

[2]Another way that banks can shield loan growth from a policy-induced contraction in asset growth is to draw down on liquid assets. If small banks are less able to replace an outflow of deposits with external funds, their asset growth will have to slow relative to that of large banks. The response of small bank lending to monetary policy is consequently more sensitive to holdings of liquid assets because large banks are able to use access to external funds in order to minimize any slowdown in asset growth in the first place.

[3]The link between deposit insurance and incentives for excessive risk-taking and leverage was originally developed by Merton (1977). Keeley (1990) later documented that franchise value historically was an important check on these incentives. The effect of source-of-strength is conceptually equivalent to franchise value, as each extends the potential loss of bank owners' beyond their initial equity stake in the bank. There is evidence that this mechanism is real, as Grossman (2001) documents that banks subject to double liability in the early 1900's were less likely to fail.

[4]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. See Peek and Rosengren (1997a). 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 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.

[5]For all regressions in this paper, I use a two-step procedure in order to eliminate the influence of outliers on coefficient estimates. Each regression is initially estimated by OLS, and then the DFITS statistic described in Welsch and Kuh (1977) is used to identify and eliminate influential observations. DFITS is the scaled difference between the predicted values for the ith observation when the regression is estimated with and without the ith observation. In practice, about one percent of observations are eliminated from each specification.

[6]In particular, it is likely there are omitted variables in a regression of loan growth on liquidity. To fix ideas, assume that the bank customer mix is correlated with both loan growth and liquidity, but it is not observed, implying that the first-stage is inconsistent. If the way that customer mix affects lending is correlated with monetary policy, the second-stage standard errors are not correct. The evidence developed below indicates that controls for small loan concentration have important effects when measuring the response of lending to monetary policy across multi-bank holding company affiliation. Moreover, bootstrapping is not practical given the size of the data set employed, especially in the presence of heteroskedasticity.

[7]To make this completely clear, I use three macro variables in the analysis, and up to a dozen bank-level control

variables. Including the interaction of four lags of each macro variable with each of the bank-level control variables would require 144 variables in addition to the 24 underlying main effects. The data set becomes larger than 500 megabytes in no time, which is the RAM quota on the UNIX machine used in the analysis.

[8]Note that the longer sample included several years before 1990, indicating that the effect of policy on lending before the Accord was not much different than several years after it was implemented.

[9]See Jayaratne and Strahan (1996) for a full discussion of bank branch deregulation. The number of holding companies with banks in more than one state was only around 100 in the late 1970s but had increased to almost 1000 by 1990.

[10]In a longer version of the paper, I also develop weak evidence that the lending channel is stronger during state booms than state recessions. As monetary policy is typically counter-cyclical, lending is constrained by the supply of insured deposits during a boom – forcing banks to turn to large CDs – while unconstrained during a recession. This stands in contrast to the balance sheet channel which is thought to be much stronger during recessions when firm creditworthiness has deteriorated. See Bernanke, Gertler, and Gilchrist (1996). This is further evidence that affiliation with a bank holding company is measuring variation across banks in financial constraints and not in customer mix.

[11]Obviously this becomes 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.

[12]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 recent data control for the small business lending concentration of banks affiliated with MBHCs and small banks separately.

[13]The response of lending to output likely reflects a lower marginal product of capital (a classical decline in loan demand) and a deterioration in firm balance sheets (tighter firm-level financial constraints). The direct response of bank lending to the federal funds rate will be an upper bound on the response of loan supply because a higher funds rate will be passed along to firms in the form of a higher loan rate, reduces demand through the standard interest rate channel. In addition, an increase in interest rates can immediately affect interest coverage on flexible-rate or short-term debt, making borrowers less creditworthy. Either of these factors could lead to decrease in lending that has little to do with the inability of banks to substitute from insured deposits to large CDs and federal funds.

[14]Note that this estimate is in line with the aggregate response of output to loan supply when decomposed in this manner. The restricted response of real GDP through the lending channel is only 2 basis points after one year, which implies a aggregate elasticity of real GDP to bank loan supply of about 10 percent.

Table 1: Descriptive Statistics

	All Banks		Size		Leverage		MBHC affiliation			
	1986	1996	Small	Large	Low	High	One-bank	MBHC	One-bank	MBHC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Assets	189	255	80	3,615	213	2,975	167	534	75	95
2. Loans	51.7	57.7	57.4	62.1	57.6	60.1	56.8	60.6	56.6	60.2
3. Small loans		75.9	77.9	29.7	76.2	56.0	77.9	69.6	79.3	73.1
4. Securities	35.3	34.2	34.5	28.2	34.2	29.1	35.1	31.2	34.2	31.9
5. Core deposits	78.6	76.2	76.8	65.4	76.3	73.7	76.3	75.8	76.8	76.9
6. Equity	8.6	10.4	10.4	9.0	10.5	5.4	10.6	9.6	10.7	9.7
7. Finance mix	87.6	87.2	87.6	76.7	87.2	82.3	87.4	86.3	87.8	87.1
8. Loan losses	1.6	1.6	1.6	1.8	1.6	1.7	1.6	1.6	1.6	1.5
9. Internal capital	7.0	6.0	5.89	9.4	6.1	4.2	5.8	6.8	5.7	6.6
10. Loan commitments		19.2	16.6	76.9	19.3	16.9	18.5	21.4	16.0	18.8
11. Letters of credit		0.9	0.7	4.9	0.9	1.8	0.8	1.2	0.7	0.7
12. Holding company	68.2	77.2	76.6	89.5	77.2	77.2	70.0	100	69.6	100
13. Multi-bank company	29.0	24.0	22.9	45.8	23.9	30.9	0	100	0	100
14. MBHC Assets	1,106	1,224	590	13,400	1,028	13,900	220	4,396	87	2,283
15. Small bank	95.0	95.0	100	0	95.3	75.6	96.5	90.5	100	100
16. Small holding company	83.0	86.5	91.0	0	86.8	65.0	96.1	56.4	99.6	62.2
17. Binding leverage	14.1	1.5	1.2	7.5	0	100	1.4	2.0	1.3	1.1
18. Loan growth	5.6	12.3	12.3	12.4	12.2	16.1	12.5	11.7	12.4	11.9
19. Core deposit growth	10.6	7.6	7.6	7.6	7.5	12.0	7.8	6.9	7.8	7.0
20. Lagged change in equity	-0.46	0.38	0.38	0.39	0.40	-0.48	0.30	0.42	0.29	0.42
21. Number of insured banks	12,823	8,050	7,650	400	7,927	123	6,114	1,936	5,897	173

Table Notes: Data refer to the population of insured commercial banks. Columns 3 to 10 refer to December 1996. Assets (line 1) and multi-bank holding company (MBHC) assets (line 14) are reported in millions of dollars while all other variables are reported in percentage terms. Loans (line 2), securities (line 4), core deposits (line 5), and equity (line 6) are measured relative to assets. Small loans (line 3) are measured relative to total loans covered the small business loan supplement. The finance mix (line 7) 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 (lines 9-11) are measured relative to total loans. Small banks (line 15) and small bank holding companies (line 16) are defined at the 95th percentile of the national distribution of bank assets. Binding leverage standards (line 17) are approximated by an equity ratio of less than 6 percent.

Table 2: Sensitivity of Loan Growth to Core Deposit Growth

Sample	1987-99	1976-86
	(1)	(2)
1. $Intercept$	-0.04	-13.16
	(1.78)	(1.18)
2. $\Delta ln(Deposits)$	132.38	221.69
	(28.38)	(11.85)
3. $MBHC$	0.73	0.56
	(0.57)	(0.30)
4. $ln(Assets)$	0.27	1.32
	(0.17)	(0.12)
5. $Securities$	2.07	9.10
	(1.07)	(0.82)
6. $CapitalSurplus$	13.88	-8.68
	(10.44)	(3.32)
7. $BindingLeverage$	-6.64	-0.62
	(0.36)	(0.71)
8. $InternalCapital$	-0.02	0.87
	(0.03)	(0.77)
9. $ln(Assets) * \Delta ln(Deposits)$	-6.54	-15.01
	(2.80)	(1.25)
10. $MBHC * \Delta ln(Deposits)$	-17.74	-4.51
	(8.76)	(2.71)
11. $Securities * \Delta ln(Deposits)$	13.88	-24.06
	(25.58)	(7.39)
12. $CapitalSurplus * \Delta ln(Deposits)$	-44.80	-24.92
	(16.18)	(8.63)
13. $BindingLeverage * \Delta ln(Deposits)$	15.24	5.41
	(7.33)	(8.35)
14. $InternalCapital * \Delta ln(Deposits)$	-0.02	7.52
	(0.01)	(4.24)
15. Time Effects	Yes	Yes
16. R^2	0.31	0.38
17. Observations	135,120	137,681

Table Notes: The table refers to an annual frequency regression of 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. All coefficients and standard errors have been multiplied by 100.

Table 3: The Response of Loan Growth to Monetary Policy Across Bank-Level Financial Constraints

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. $Intercept$	-64.93	-43.81	-39.31	-66.99	-30.49	-71.52	-37.11
	(46.85)	(9.86)	(9.75)	(46.76)	(49.85)	(46.91)	(49.97)
2. $MBHC * \Delta r_t$	0.42			0.56	0.38	0.96	0.88
	(0.15)			(0.15)	(0.15)	(0.16)	(0.17)
3. $ln(Assets) * \Delta r_t$	0.28				0.23		0.08
	(0.11)				(0.10)		(0.11)
4. $CapitalSurplus * \Delta r_t$	-3.52				-9.48		-5.88
	(3.77)				(3.54)		(3.55)
5. $BindingLeverage * \Delta r_t$	1.21						
	(0.39)						
6. $Securities * \Delta r_t$	0.62				1.02		0.80
	(0.48)				(0.48)		(0.47)
7. $InternalCapital * \Delta r_t$	0.06				0.06		0.06
	(0.01)				(0.01)		(0.01)
8. Δr_t		0.68	-0.45	-0.76	-1.96	-0.84	-1.82
		(0.05)	(0.09)	(0.16)	(1.17)	(0.15)	(1.32)
9. $MBHC * \Delta r_t * Early$							
10. Time Effects	Yes	No	No	No	No	No	No
11. Basle Controls	No	No	Main	Main	Main	Interactive	Interactive
12. Sample	1986-99	1986-99	1986-99	1986-99	1986-99	1986-99	1986-99
13. R^2	0.14	0.11	0.11	0.12	0.13	0.12	0.13
14. Observations	130,935	130,988	131,007	131,006	131,113	130,974	131,053

Table Notes: The table refers to a regression loan growth on one lag, various measures of financial constraints, the one-year change in the federal funds rate Δr_t, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. 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. All coefficients and standard errors have been multiplied by 100.

Table 4: Robustness Exercises

	(1)	(2)	(3)	(4)	(5)
1. $Intercept$	100.05	-55.73	39.90	49.83	-111.86
	(36.51)	(13.77)	(138.57)	(146.62)	(22.59)
2. $MBHC * \Delta r_t$	0.98		0.88	0.70	0.70
	(0.22)		(0.22)	(0.25)	(0.15)
3. $ln(Assets) * \Delta r_t$	0.48			0.30	0.29
	(0.15)			(0.18)	(0.03)
4. $CapitalSurplus * \Delta r_t$	4.28			-11.37	-2.30
	(4.50)			(9.14)	(1.58)
5. $BindingLeverage * \Delta r_t$	1.92				-0.56
	(0.62)				(0.08)
6. $Securities * \Delta r_t$	2.63			3.21	-0.02
	(0.83)			(1.03)	(0.15)
7. $InternalCapital * \Delta r_t$	-3.04			0.11	0.18
	(0.93)			(0.38)	(0.04)
8. $Commitments * \Delta r_t$	0.02				
	(0.15)				
9. $SmallLoans * \Delta r_t$	3.59				
	(0.56)				
10. Δr_t		-0.41	-0.89	-4.75	
		(0.09)	(0.21)	(2.02)	
11. $MBHC * \Delta r_t * Early$					-0.78
					(0.15)
12. Time Effects	Yes	No	No	No	Yes
13. Basle Controls	No	No	No	No	Yes
14. Sample	1993-99	1993-99	1993-99	1993-99	1976-99
15. R^2	0.14	0.11	0.13	0.14	0.14
16. Observations	61,403	61,907	61,886	61,916	251,322

Table Notes: The table refers to a regression loan growth on one lag, various measures of financial constraints, the one-year change in the federal funds rate Δr_t, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. 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. All coefficients and standard errors have been multiplied by 100.

Table 5: Using Quarterly Data

	Loans	
	1986-99	1993-99
	(1)	(2)
1. $MBHC * \Delta r_{t-1}$	0.46	0.62
	(0.16)	(0.23)
2. $MBHC * \Delta r_{t-2}$	-0.27	-0.22
	(0.13)	(0.21)
3. $MBHC * \Delta r_{t-3}$	0.16	-0.1
	(0.16)	(0.26)
4. $MBHC * \Delta r_{t-4}$	0.09	0.03
	(0.11)	(0.28)
5. Sum of coefficients	0.44	0.33
6. P-value	0.02	0.02
7. R^2	0.08	0.09
8. Observations	546,337	255,324

Table Notes: The table refers to a quarterly frequency regression of loan growth on four lags, various bank characteristics, four lagged changes in each of the federal funds rate Δr_{t-k}, aggregate output growth, inflation, and each measure of financial constraints interacted with each macro variable. The table only reports coefficients on the interaction of affiliation with a multi-bank holding company (MBHC) with each lagged change in federal funds rate and their standard errors, which have been corrected for heteroskedasticity and clustering at the bank level. The p-value is reported from a test of the hypothesis that the sum of coefficients is not equal to zero. All coefficients and standard errors have been multiplied by 100.

Table 6: The Lending Channel: The Effects of Monetary Policy on Income through Bank Lending

A. 1987-1999.	$\Delta ln(Loans)_{st}$ (1)	$\Delta ln(Income)_{st}$ (2)	$\Delta ln(Income)_{st}$ (3)
1. $\sum_{k=1}^{4} \theta_k^{mbhc} \Delta r_{t-k}$	11.52	-1.05	
	(5.16)	(0.78)	
2. $\Delta ln(Loans)_{st}$			-9.09
			(5.92)
3. Estimation Method	OLS	OLS	IV
4. P-value	0.03	0.18	0.13
5. R^2	0.30	0.36	
6. Observations	2,652	2,652	2,652

B. 1993-1999.	$\Delta ln(Loans)_{st}$ (1)	$\Delta ln(Income)_{st}$ (2)	$\Delta ln(Income)_{st}$ (3)
7. $\sum_{k=1}^{4} \theta_k^{mbhc} \Delta r_{t-k}$	18.04	0.44	
	(7.96)	(1.80)	
8. $\Delta ln(Loans)_{st}$			-8.45
			(7.81)
9. Estimation Method	OLS	OLS	IV
10. P-value	0.02	0.81	0.29
11. R^2	0.27	0.47	
12. Observations	1,428	1,428	1,428

Table Notes: The first two columns of the table refer to a quarterly frequency regression of aggregate state loan (columns 1) or income growth (columns 2) on four lags of the dependent variable, various measures of state-level financial constraints, four lagged changes in the federal funds rate Δr_{t-k}, and each measure of state-level financial constraints interacted with each lagged change in the funds rate. State-level covariates include the loan market share of banks affiliated with multi-bank holding companies θ_t^{mbhc} the loan market share of small banks, aggregate banking assets, liquidity, equity ratio, internal capital, and the fraction of banks with low capital ratios. In Panel B, these covariates also include the small loan concentration of MBHC-affiliated and small banks, including the proper interactions with macro variables. In line 1 and 7, the table reports the sum of coefficients on the interactions of θ_t^{mbhc} with each change in federal funds rate and standard errors in parenthesis. The third column reports coefficients and standard errors from a instrumental variables regression of state income growth on state loan growth with the same covariates as in the first two columns, where instruments include interactions of θ_t^{mbhc} with four lagged changes of the federal funds rate. All coefficients and standard errors have been multiplied by 100.