Macroeconomic Implications of Bank Loan Commitments

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October 2, 2007

[1] I am especially indebted to discussion with Randall Kroszner, Susanne Schennach, Atif Mian, Craig Furfine, Anil Kashayp, Amir Sufi, Jean Imbs and the participants at the Macro/International Workshop at the University of Chicago and the seminar at the Federal Reserve Board. I also would like to thank Adam Ashcraft and Richard Rosen for providing the most recent merger file of commercial banks, Donald Morgan and Philip Strahan for their data on interstate banking measures, and Beverly Hirtle for hard copies of her papers. All remaining errors are mine. The usual disclaimers apply.

Abstract

This paper analyzes how bank loan commitments affect loan supply and macroeconomic volatility. Using testable implications derived from a model in which a bank faces stochastic loan commitment takedown, our bank-level empirical test provides evidence that when financial markets get tighter, increased loan takedown crowds out loans made without commitment, implying asymmetric effects depending on the relative access to loan commitments and ordinary term loans. At the state level, we find macroeconomic volatility tends to rise as market-wide liquidity dries up and loan commitments tend to stabilize the economy by partially offsetting negative liquidity shocks. This evidence adds support to the financial market explanation for the causes of increased stability of the U.S. economy from the early 1980s.

(JEL: E40, E44, G21)

1 Introduction

This paper presents empirical evidences for how bank loan commitments affect the loan composition of commercial banks and macroeconomic stability.[1] Our empirical exercise suggests that: (1) at the bank-level, loan commitment takedown not only increases during tight periods but also crowds out the amount of term loans to be issued, implying an asymmetric effect associated with relative usage of loan commitments and term loans, and (2) the state-level test shows that economic volatility rises as market-wide liquidity becomes scarce and that loan commitments dampen negative shocks, contributing to increased macroeconomic stability. This suggests that bank loan commitments play the role of an insurance device for additional funding during bad times.

Two lines of empirical facts and literature motivated this paper. First, the use of bank credit lines has been increasing over time. As Figure 1 shows, the amount of unused loan commitments outstanding in off-balance sheets of commercial banks has been increasing steadily from the early 1980s and it is almost as large as the amount of total loans made as of 1999:IV. Also, Federal Reserve Statistical Release E.2 as of May 2005 reports that the share of commercial and industrial (C&I) loans made under commitment amounts to 88 percent of the total C&I loans made. As shown in Table 1 (line 13), statistics from the Federal Reserve's Report of Condition and Income, the so-called "Call Reports," document the increased use of loan commitments in all sizes of banks and regardless of bank holding company (BHC, henceforth) affiliation. Given this increased significance of loan commitments in the commercial banking sector, there are few empirical studies with macroeconomic implications.[2] In this regard, it is worthwhile to look

[1] In this paper, loan commitments and lines of credit are used synonymously; "term loans" refer to commercial bank loans not made under commitment.

[2] Due to its interesting properties of option-like exercise and complicated fee structures, previous studies have focused more on its micro level implications. For example, Morgan (1993) and Shockley and Thakor (1997) focus on incentive problems of loan commitment contracts. Boot and Thakor (1991) and Avery and Berger (1991) study credit risk resulting from issuing loan commitments. Chava (2004) reveals its positive informational value

at how bank loan commitments affect bank loan supply or loan composition and to see if such reshuffling in loan composition may have macroeconomic implications.

Secondly, there have been active debates on "the Great Moderation," the substantial decline in macroeconomic volatility over the past twenty years or so.[3] Recently, some empirical studies have focused on the role of financial innovations. Morgan, Rime, and Strahan (2004) suggest that interstate banking deregulation, which allows funds to flow across states more freely, contributes to increased economic stability. Dynan, Elmendorf, and Sichel (2006) argue that financial innovations beginning in the early 1980s appear to have increased the marginal availability of funds and have reduced economic volatility. In addition, Park (2006) argues that the amount of loan commitments in commercial banks' off-balance sheets is closely tied to the interstate banking measures used in Morgan, Rime, and Strahan (2004), suggesting that interstate banking lowers agency costs through internal capital markets and encourages banks to issue more loan commitments.[4] Given these factors, the following question naturally arises: Is there any macro level real effect associated with loan commitments? Our state-level empirical results provide an affirmative response to this question. It appears that loan commitments make the economy less volatile when financial markets tighten. Robustness tests shows that neither state-level industrial structures nor other bank balance sheet variables can explain this finding. Additionally, this finding is robust to outliers, output measures, and sample periods.

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using option-pricing models. Ergungor (2001) ia a good survey on contractual properties of loan commitments.

[3]Broadly speaking, three types of explanations have been provided for this drastic change: structural changes, better macroeconomic policies, and good luck (McConnell and Perez-Quiros (2000), Stock and Watson (2002), Taylor (2000)). Explanations focusing on structural changes suggest changes in economic institutions, technology, and business practices help the economy to absorb external shocks. Recent studies have begun to focus on financial market development and the empirical results presented in this paper are in line with this financial factor.

[4]Loan commitments necessarily involve liquidity management problem since banks need to maintain some amount of liquidity in order to meet firms' loan takedown demand. The model in the Appendix makes this point clear: banks with lower agency costs will issue more loan commitments.

Our empirical results complement and extend those of Morgan (1998) and Morgan, Rime, and Strahan (2004). Morgan (1998) reports that bank loans not made under commitment slow after tight policy, while loans under commitment accelerate or are not affected, which he interprets as evidence for the existence of bank lending channel. While he examines the times series of two kinds of loans after shocks, I focus on the *cross-sectional* difference: how banks respond to increased loan takedown and how their responses are different depending on their access to external financing or internal capital markets.[5] I find that banks with more limited access to financing tend to reduce their term loans in dealing with increased loan takedown when market-wide liquidity is scarce. This result suggests that liquidity shock will have a disproportionate effect on the economy depending on the relative usage of bank loan commitments.

Morris and Sellon (1995) observe the strength in business lending after a decline in industrial production and conjecture that it may be caused by an increased demand for loans to finance an unanticipated rise in unsold inventories. In their view, banks appear to be providing additional liquidity rather than restricting liquidity. This line of reasoning is completely consistent with the patterns of loan commitments observed here. Following this, the second part of my empirical study investigates whether loan commitments have macroeconomic implications. Borrowing the measure of economic volatility used in Morgan, Rime, and Strahan (2004), the state-level test shows that economic volatility tends to rise as market-liquidity dries up and that loan commitments partially offset liquidity shocks, thereby contributing to macroeconomic stability. Considering that the use of loan commitments has been increasing following financial market developments starting from the early 1980s, this result provides one potential explanation for how interstate banking deregulation lowers economic volatility. One possible mechanism is that more loan commitments, prompted by interstate banking deregulation, contribute to increased stability. Hence, like Dynan, Elmendorf, and Sichel (2006) and Morgan, Rime, and Strahan

[5] Morgan (1998) uses the Federal Reserve Board's Loan Commitment Survey, which covers the period between January 1975 and June 1987 and includes information on the *used* amount of loan commitments. Since Call Reports do not have such information, my test is rather indirect. This issue will be discussed in Section 3.

(2004), the results in this paper support the financial market explanation for the causes of the Great Moderation.

The rest of the paper proceeds as follows. Section 2 discusses possible links among bank loan commitments, loan supply, and macroeconomic volatility. In Section 3 and 4, empirical tests at the bank-level and state-level are presented with various robustness checks. Section 5 discusses implications for future research and concludes.

2 Loan Commitments, Loan Supply and Macroeconomy

Our goal is to gain an empirical sense of the macroeconomic implications of bank loan commitments. In this section I describe the possible links between loan commitments, bank loan supply behavior, and economic volatility based on the implications of the model in the Appendix.

Concerning our first question of how a bank responds to increased loan takedown, there are two related empirical studies. Morgan (1998) reports that bank loans not made under commitment slow after tight policy, while loans under commitment accelerate or are not changed; Gatev, Schuermann, and Strahan (2006) show that banks with more preexisting liens of credit experience more takedown demand when paper-bill spreads widen. If we define R as

$$R \equiv \frac{\text{amount of loans made under commitments}}{\text{amount of loans not made under commitments}}$$

, then the results of Morgan (1998) and Gatev, Schuermann, and Strahan (2006) can be expressed as $\partial R_{it}/\partial M_t > 0$ and $\partial^2 R_{it}/\partial M_t \partial C_{it} > 0$, where R_{it} is the bank-level variable as defined above, C_{it} is the amount of unused credit lines, M_t is a measure of market-wide liquidity (with higher values of M_t corresponding to scarce market-wide liquidity). We take one step further and look for any cross-sectional differences, $\partial^3 R_{it}/\partial C_{it} \partial M_t \partial \alpha_i$ where α_i is a measure of agency cost. If a bank does not want to see its liquid asset holdings sink to a dangerously low level, it seeks ways to increase its liquid assets: It can do so by raising funds from external sources or member banks and cutting term loans. If a bank find it harder to borrow from external providers, it tends to cut down term loans. I argue that relative availability of funding (be it internal or external funds) constitutes this difference. If a bank experiences increased loan takedown, it will raise the value of the numerator in R. In addition, if a bank reduces its term loans to manage its liquidity level, we expect the denominator in R to decrease. Thus, high agency cost banks will show higher increases in R. This logic will lead to our first hypothesis, $\partial^3 R_{it}/\partial C_{it} \partial M_t \partial \alpha_i > 0$.[6]

If our hypothesis turns out to be true, it implies heterogenous responses from liquidity shock depending on the relative usage of loan commitments and ordinary term loans. Sofianos, Wachtel, and Melnik (1990) use VAR and find evidence of a smaller impact of monetary policy on loans made under commitment agreements than on loans not made under commitment. They conclude that loan commitments effectively insulate borrowers from the effect of credit rationing and they force monetary policy to work exclusively through the interest channel.[7] In a similar study, Hirtle (1990) suggests that the size of the loan commitment market is a proxy for the share of corporate borrowers that are no longer dependent on banks for credit. As the share of non-bank dependent corporate borrowers increases, monetary policy in the banking sector will have to work more exclusively through the interest channel. Gatev and Strahan (2006) shows that banks can insure firms against systematic declines in liquidity at lower cost than other institutions.[8] As a more concrete example, take commercial paper backup lines provided by banks. By relying on these backup lines (i.e., loan commitments), commercial

[6] One main obtacle to track down R is that Call Reports do not separately record the amount of loans made under commitments and the amount of loans without commitments. To get around this problem, we adopt an indirect method of looking at C&I loans, most of which are made under commitments. The following section will explain this in detail.

[7] Like Morgan (1998), they use the Federal Reserve Board's Loan Commitment Survey. One difference is that they use a monetary aggregate of M1 for monetary policy stance while Morgan (1998) uses Romer dates.

[8] One may ask how banks can provide additional funding even in bad times. Recent studies by Gatev, Schuermann, and Strahan (2005) and Gatev and Strahan (2006) support this claim by showing that, during the 1998 crisis, banks experiencing a large inflow of transaction deposits provided liquidity to firms using commercial paper backup lines. They also present an evidence that this deposit-lending synergy is more powerful during a crisis, when nervous investors move their funds into the banking sector.

paper issuers can hedge supply shocks to their funding. The role of banks as liquidity insurance providers originated early in the development of the commercial paper market, especially after the bankruptcy of Penn Central Transportation Company. Additionally, banks can offer lower prices for them because, when market liquidity becomes scarce, deposit inflows into banks make their funding costs cheaper and better suited to this purpose of serving as additional funding sources.[9] Moreover, given our finding that the ratio of C&I loans to total loans increases during contractionary periods and this increase is well-explained by the amount of loan commitments outstanding, loan commitment is more than a proxy for financial market developments by virtue of constituting an actual source of funds to firms. This suggests that lines of credit issued by commercial banks function like an insurance device by becoming an additional source of funds during recessions. In light of these facts, we have many reasons to expect macroeconomic implication of bank loan commitments.

Since we expect financial frictions to be less important with loan commitments, firms with access to additional funding suffer less from systematic risk.[10] These conjectures lead us to our second hypothesis: $\partial^2 F_{it}/\partial M_t \partial C_{it} < 0$ where F is a measure of economic fluctuations. That is, economic volatility will be smaller with more loan commitments when liquidity shock hits the economy. Note that, unlike our first hypothesis, the sign of $\partial^2 F_{it}/\partial M_t \partial C_{it}$ is an empirical problem since we do not have a related model predicting its sign. And, as our bank-level result reveals, if term loans are crowded out by increased loan takedown and the marginal negative effect of reduced term loans outweighs the marginal positive effect of increased loan takedown, we would expect the opposite sign, $\partial^2 F_{it}/\partial C_{it} \partial M_t > 0$. The empirical test in the following section will reveal which effect is more likely to prevail.

[9] This comparative advantage argument for banks' issuing of loan commitments is well-documented in Kashyap, Rajan, and Stein (2002) and Gatev and Strahan (2006).

[10] Dynan, Elmendorf, and Sichel (2006) argue changes in financial markets and institutions that facilitate borrowing should have more effect on the consumption responses to negative income deviations than to positive ones.

3 Empirical Analysis

3.1 Data

In the analysis below, I use quarterly data from Call Reports for the populations of all insured commercial banks.[11] In compiling a consistent dataset, I borrow the variable definitions and exclusion criteria used in Kashyap and Stein (2000), Campello (2002) and Ashcraft (2006). One must be careful in compiling consistent time-series data since there are changes in accounting practices and numerous bank mergers which introduce jumps in balance sheet variables. Call Reports are available starting from 1976. However, the sample period in the analysis is limited to 1984:II-1999:IV. It begins in 1984 because this is the first year for which loan commitment data is available. The sample period ends in 1999 because changes in the Call Reports forms employed after 2000 make it very difficult to construct a consistent time-series. Total unused commitment series are available from 1984:II while other commitment-related variables such as credit card lines and commitment to fund loans secured by real estate are available from 1990:I or 1991:I.

Call Reports data are valuable because they give the population of all commercial banks instead of just a sample. They also provide detailed information on bank balance sheets, although some numbers are missing or incorrect. To fix this problem and to remove outliers, all of the observations which are not considered normal operations of banks are excluded. Specifically, observations of bank-quarters with asset growth in excess of 50 percent, those with commitments-to-total loans ratio exceeding 4, those with a ratio of total loans to asset below 10 percent, and those with total loan and C&I loan growth rates exceeding 100 percent are excluded. In addition, the observations with a ratio of non-performing loans to total loans in excess of 50 percent and with a ratio of C&I loans to total loans exceeding 100 percent are not considered. To make regressions with four lags possible, all of the bank entities with fewer than five consecutive

[11] For other data sources and variable definitions, see the Appendix.

quarters are removed from the sample as well. These criteria remove approximately 7.7% of the observations from the population of 812,970 bank-quarter observations. Because bank-quarter observations that are involved in mergers may create jumps in balance sheet variables unrelated to real economic activity, I use the most recent merger file from the Federal Reserve Bank of Chicago that is used in Ashcraft (2006).

The top 1 percent of banks in terms of average assets during the sample period are categorized as 'large banks.' Banks falling below the top 1 percent and above the top 5 percent are referred to as 'medium banks' and those below the top 5 percent are 'small banks.' If a bank is affiliated with a BHC, it is a member of a BHC. Otherwise, it is referred to as a stand-alone bank.

Table 1 displays some changing patterns over time and across bank size/BHC-affiliation. Banks' holdings of cash and security (line 2 and 3) fall over time. For example, while large banks in 1985 hold 30 percent of liquidity to assets, they hold 26 percent as of 1999:IV. Also, banks rely less on deposits in their financing, as documented in line 8, 9, and 10. This evidence can be interpreted as lower agency costs of banks' external financing. Note that this pattern is also consistent cross-sectionally as well as in the time-series context. Large banks and BHC-member banks, who are deemed to have lower agency costs compared to small and stand-alone banks, display low shares of liquid assets and deposits. In addition, the share of nonperforming loans (line 7) has been decreasing over time, reflecting better risk management. It appears that lower agency cost and more sophisticated risk management allow banks to issue more and more loan commitments over time (line 12). The following bank-level test looks for any cross-sectional differences associated with agency costs and their implications for the economy.

3.2 Bank-Level Test

3.2.1 Empirical Specification

Pursuing the model's implication, we are going to test whether loan commitments crowd out term loans when financial markets are tighter. Our discussion in Section 2 leads us to present the first hypothesis: $\partial^2 R_{it}/\partial M_t \partial C_{it} > 0$ and $\partial^3 R_{it}/\partial M_t \partial C_{it} \partial \alpha_i > 0$. When financial markets are tighter, the share of loans made under commitments tends to increase with the amount of loan commitments as firms take down more funds ($\partial^2 R_{it}/\partial M_t \partial C_{it} > 0$) and this tendency is more pronounced when a bank faces higher agency cost ($\partial^3 R_{it}/\partial M_t \partial C_{it} \partial \alpha_i > 0$).

In making this estimation, one significant obstacle is that Call Reports do not record the amount of loan takedown as a separate item. What is available is the unused amount of loan commitments in off-balance sheets and loans, which reflect the sum of loan takedown and term loans. If we could observe the amount of loan takedown separately, our empirical test would be easier and its interpretation more straightforward. For example, if such data were available, we could directly test whether the ratio of loans made under commitments to non-commitment term loans increases in bad times and if this tendency is more pronounced for banks with more limited access to external financing. Unfortunately, this approach is not readily implementable due to the unavailability of such data. To bypass this problem, we are going to pursue a rather indirect and partial test of this hypothesis by looking at one category of loans, C&I loans.

Although we focus on C&I loans due to data unavailability, C&I loans offer several positive features for this test. Firstly, there is a corresponding loan commitment category for C&I loans in Call Reports, which is an item of RCFD3818. RCFD3818 is also referred to as "other unused commitments" among the subcategories of loan commitments and they are mainly obligations to supply loans to commercial and industrial firms. Thus, loan takedown from "other unused commitments" will be added to C&I loans. Secondly, as recent Federal Reserve Statistical Releases indicate, most C&I loans are made through loan commitments. In this regard, we don't have to worry much about the amount of C&I *term loans* to be crowded out by C&I loan commitments and we can focus more on the effect of C&I loan commitments on the relative shares between C&I loans and loans in other categories.

Following the logic presented in the previous section, if loan takedown from C&I loan commitments increases during tight periods and forces a bank to reduce its term loans in other loan categories, we expect that: (1) the share of C&I loans to total loans will increase with the amount of C&I loan commitments in bad times. That is, ∂^2(C&I loans/total loans)/$\partial M \partial COM > 0$ where COM is the share of "other unused commitments" for C&I loans to total loans. We also expect that (2) to the degree that the increased C&I loan commitment takedown discourages a bank from issuing new term loans, this effect of increasing the share of C&I loans to total loans will be bigger since it make total loans (or total loans minus C&I loans) shrink or increase less compared to C&I loans. Based on this reasoning, we expect ∂^3(C&I loans/total loans)/$\partial M \partial COM \partial \alpha > 0$.[12]

In order to identify these two effects correctly, it is essential that we have variations only in the ability of external financing or agency cost (α) and not in the loan demand conditions. To do this, we are going to compare BHC-member banks with similar-sized stand-alone banks, as done in Campello (2002) and Ashcraft (2006). Using BHC-affiliation as a source of variation in financial constraints across banks has an advantage because it permits a comparison of banks which are identical except for the membership in a BHC, possibly eliminating any unobserved differences in loan demand.[13] Since affiliated banks are expected to have better access to uninsured funds through internal capital markets, we take whether a bank is affiliated with a BHC as variation in its ability to tap uninsured funds, α. That is, BHC-affiliated banks have lower α.[14]

The regression equation takes the form of (1) in order to estimate the differential responses

[12] Some pitfalls and alternative explanations resulting from this indirect approach will be discussed below.

[13] When we make a comparison by size, we are left with unobserved differences of loan demand associated with size. One can say that large banks lend more to large customers, whose loan demand is less procyclical. Since small firms are hit harder during recessions, there are uneven loan demands across bank sizes.

[14] One may point out the possibility of endogeneity in banks' becoming BHC-member banks or remaining as stand-alone banks. That is, individual bank characteristics may explain membership in a BHC. To check for this possibility, Campello (2002) isolate observations from independent banks that eventually merge into a large BHC during the sample period and compare their lending behavior with that of banks that remain independent. Those comparisons show no indication that premerging and nonmerging small banks respond differently to Fed policies. His findings imply that becoming a target of a merger or acquisition would be rather exogenous among small banks.

between the two groups:

$$\begin{aligned} R_{it} &= c+\sum_{j=1}^{4}\alpha_j M_{t-j}+\sum_{j=1}^{4}\beta_j M_{t-j}COM_{i,t-1}+\sum_{j=1}^{4}\gamma_j M_{t-j}COM_{i,t-1}BHC_i \\ &\quad +\varphi_A \ln(Asset)_{i,t-1}+\varphi_B B_{i,t-1}+\varphi_N NP_{i,t-1}+\varphi_C COM_{i,t-1}+\varphi_E E_{i,t-1}+\varphi_{TD} TD_{i,t-1} \\ &\quad +(\text{dummy variables})+\alpha_i+u_{i,t} \end{aligned} \quad (1)$$

where R_{it} is the ratio of C&I loans to total loans, M is a measure of financial market tightness, and COM is defined as 'other loan commitment (RCFD3818)/total loans' as a proxy for intensity of using loan commitments in issuing C&I loans. The dummy variable BHC_i takes 1 if a bank is affiliated with a BHC. To control for bank size effect, log of bank asset is added. The ratio of security to total assets (B) and the ratio of bank equity to total assets (E) are included in the regression to represent a bank's liquidity position. As a proxy for loan quality, the ratio of non-performing loans to total loans (NP) is included. The ratio of transaction deposits to total assets, a proxy for insured funds sources, is also included. Other dummy variables included are dummies of time, Federal Reserve district, BHC-affiliation, quarterly effect and credit crunch during the period of 1990:I-1993:IV. The variable M should be a measure of overall market-wide liquidity. I use the 6-month paper-bill spread and federal funds rate.[15]

Our interest lies in two sums of coefficients, $\sum\beta_j$ and $\sum\gamma_j$. $\sum\beta_j$ captures the common effect associated with the corresponding explanatory variable ($M\cdot COM$) while $\sum\gamma_j$ picks up the differential responses between the two groups. Our model predicts $\sum\beta_j>0$ and $\sum\gamma_j<0$. The first one, $\sum\beta_j>0$, seems natural if loan takedown from C&I loan commitments increases during high interest periods. For the second one, there can be several explanations for non-zero $\sum\gamma_j$, which will be discussed below.

3.2.2 Alternative Interpretations

Before turning to the results, we discuss an issue that could pose a problem. Since we have adopted a rather indirect test using C&I loans in order to bypass the data unavailability problem,

[15] Gatev and Strahan (2006) also use the paper-bill spread to measure market liquidity.

it is important to ascertain whether the differential responses between the two groups could be interpreted in another way.[16] I identify two alternative interpretations for non-zero $\sum \gamma_j$ below and argue that those explanations actually strengthen our initial interpretations: increased loan takedown crowds out term loans.

The first candidate explaining non-zero $\sum \gamma_j$ is the crowding-out effect of loan commitments, which is our hypothesis. Given the equal size of loan takedown from C&I loan commitments, our model predicts that banks with more limited access to external financing or internal capital markets will reduce more of their term loans to deal with increased loan takedown, which will put downward pressure on the denominator of our dependent variable.[17] If this mechanism works, then we expect $\sum \gamma_j$ to be negative. We can interpret the negative $\sum \gamma_j$ as the benefit of internal capital markets in dealing with the pressure of reshuffling between loan takedown and term loans, which is caused by the increased takedown in bad times. That is, our hypothesis says that the response of our dependent variable to loan commitments in bad times should be bigger for stand-alone banks, implying $\sum \beta_j > \sum \beta_j + \sum \gamma_j$.

The second explanation arises from the possibility of firms' endogenous choices of banks. Suppose there is a firm whose loan demand is relatively more countercyclical. If it expects a BHC-member bank to better meet its loan demand in bad times due to the bank's internal capital market and they strategically choose it rather than a stand-alone bank, there should be more loan takedown for BHC-member banks given the same shock to both groups. In this case, because BHC-member would experience more loan takedown compared to stand-alone banks, we expect $\sum \gamma_j > 0$.

Invoking MAC (Material Adverse Change) clauses and using covenants on loan commitment contracts also have the potential to explain non-zero $\sum \gamma_j$.[18] It is expected that less liquidity-

[16] I thank Randall Kroszner and Amir Sufi for pointing out these possibilities.

[17] It is possible to define our dependent variable R as the ratio of C&I loans to non-C&I loans. That is, C&I loans/(total loans−C&I loans).

[18] Banks can get out of their obligations under certain circumstances by citing MAC clauses. Nevertheless, in reality, it appears that courts have often obstructed banks' right to invoke MAC clauses and to deny credit to a

constrained banks will rely less on these measures given the equal size of loan takedown shock. Thus, BHC-member banks, which have internal capital markets, will provide more funds in the face of the same amount of loan takedown requests, implying again $\sum \gamma_j > 0$.

Among these explanations for non-zero $\sum \gamma_j$, our model predicts $\sum \gamma_j < 0$, which can serve as indirect evidence that loan commitments crowd out term loans during tight periods. The following empirical results will show which factors are more likely to prevail.

3.2.3 Results

Table 2 and 3 reports the coefficients we are interested in. Various specifications are estimated in order to see whether other bank-level variables or specific time/regional effects drive our results. Comparing the results from Specification (1)-(5) in Table 2, it appears that controlling for other bank balance sheet variables is important. In addition, time- and region-related dummies explain 4% of the total variation. In this regard, I choose Specification (5) as the preferred one.

In our preferred specification, we obtain $\sum \widehat{\alpha} = 0.55$, $\sum \hat{\beta} = 4.44$, and $\sum \hat{\gamma} = -4.21$. Since the mean value of the dependent variable (R) is 17.78 percent during the sample period, it implies that the share of C&I loans increases by 0.55 percent as the paper-bill spread increases by one percent. Additionally, the increase in R associated with loan commitments is quite high at 4.44 percent, which I interpret as following from the increased loan takedown from C&I loans, which pushes up the ratio. However, note that the increase is only $\sum \hat{\beta} + \sum \hat{\gamma} = 0.23$ for BHC-member banks. This is consistent with our prediction: Since they can deal with increased

loan commitment owner, arguing that the banks had not acted in good faith (Edelstein (1991)). Additionally, if a bank is concerned about the reputation it will acquire as a result of exercising MAC clauses, invoking MAC clauses is costly in the long run. Therefore, the existence of MAC clauses does not entitle banks to abandon their obligations to loan commitments at any time. In this regard, it may be a false proposition that loan commitments with MAC clauses do not impose any credit or liquidity risk on banks. Nonetheless, it cannot be said that a loan commitment constitutes an unconditional obligation of a firm at all times. A recent study by Sufi (2007) shows that extending lines of credit depends on firms' financial conditions.

takedown using their internal capital market, they don't have to reduce their term loans by much. This is why they exhibit a smaller increase in R compared to stand-alone banks. Also, note that our key estimates, $\sum \hat{\gamma}_j$, are quite stable over specifications.

Table 3 reports some of our robustness checks which use the federal funds rate for a measure of market-wide liquidity, fixed effects regression, and a sample based on well-capitalized banks.[19] When we use the federal funds rate instead of the paper-bill spread, the size of $\sum \hat{\beta}$ and $\sum \hat{\gamma}$ get a little bit smaller. They are still highly significant, however. When we estimate only with well-capitalized banks whose equity ratio is over six percent, the coefficients become bigger. In all of the specifications, our prediction is confirmed by the data.

As discussed above, the fact that the sum of the γ's is positive supports the story of the crowding-out effect, which is our hypothesis. This cross-section differential may have an important implication because it suggests that firms with loan commitments suffer less from increased systematic risk of the economy. However, if the increased loan takedown reduces term loans, it would disproportionately and negatively affect the economic operation of term loan borrowers. In this regard, the existence of loan commitments can be good or bad for the economy, which becomes more of an empirical question.[20] In the next section we test whether loan commitments contribute to increased macroeconomic stability when aggregate financial friction rises.

3.3 Macroeconomic Volatility and Loan Commitments

3.3.1 Empirical Specification

Empirical studies on economic fluctuations or output volatility have typical measures. They are usually variances of demeaned output growth rates (Kim, Piger, and Nelson (2004)), percentage

[19] Additionally, I check the results when we estimate with one lag, $j = 1$ (not 1 to 4) and when we add other bank balance sheet variables interacted with loan commitment and the BHC dummy. These different specifications do not change our main results.

[20] Morgan, Rime, and Strahan (2004) offer a similar story. Depending on whether it is a demand or supply shock, interstate banking can lower or raise economic volatility.

deviations of real GDP from the Hodrick-Prescott trend (Taylor (2000)), absolute deviation of conditional growth rates (Morgan, Rime, and Strahan (2004)), and squared terms of demeaned growth rate. In this paper, following Morgan, Rime, and Strahan (2004), the measure of economic fluctuations is the absolute deviation from the conditional growth rate of output measures. The conditional growth rate is obtained by regressing growth rate on state dummies and time dummies in order to get rid of state- and time-specific shocks from growth rate.[21] Output measures include real personal income per capita, real personal income and employment. Also, four lags of the dependent variable are included to control for possible autocorrelations. In particular, the measure of economic fluctuation F_{it} is the absolute value of the estimated residuals from the regression equation (2).

$$(\text{output growth})_{it} = c + \sum_{j=1}^{4} \phi_j (\text{output growth})_{i,t-j} + \sum_{s=1}^{49} \theta_s D_s + \sum_{t=1}^{62} \delta_t D_t + \varepsilon_{it} \qquad (2)$$

Thus, after estimating (2), we define $F_{it} \equiv |\widehat{\varepsilon}_{it}|$ as our dependent variable.[22] F_{it} can be interpreted as the size of the deviation from the average growth for the state i during the sample period and from the average growth rate for all states in that quarter t.

Call Reports data are aggregated to state level and variables are recalculated accordingly. Thus, we have 50 states over the period of 1984:II-1999:IV, resulting in a total of 3,200 obser-

[21] In the case of real personal income and real personal income per capita, their growth rates are defined as differenced terms of log of those variables. Meanwhile, in the case of employment, I use differenced terms of level terms. This is because the standard deviation of employment growth rate is too low compared to the other two measures.

[22] Another measure of $F_{it} \equiv \widehat{\varepsilon}_{it}^2$ is also used for estimation and it does not change the main result. Hence, only the results with absolute values will be reported here. As pointed out in Morgan, Rime, and Strahan (2004), there are two good reasons to use absolute values rather than squared deviations. First, it is easier to interpret the estimated coefficients since the absolute terms keep the same unit of growth rates. Second, we may have very big outliers by using squared terms.

vations of panel data. Our basic specification to estimate is:

$$\begin{aligned} F_{it} &= c + \sum_{j=1}^{4} \alpha_j (\text{paper-bill spread})_{t-j} + \sum_{j=1}^{4} \beta_j (\text{paper-bill spread})_{t-j} COM_{i,t-1} \\ &\quad + \sum_{j=1}^{6} \phi_j IS^j_{i,t-1} + (\text{bank balance sheet control variables}) + (\text{dummies}) + \alpha_i + u_{it} \end{aligned} \tag{3}$$

where IS^j is the j th industry's ratio of sectoral income relative to total nonfarm earnings, as a proxy for industry structure or initial endowment in each state. The six included industries are construction, manufacturing, finance, services, government, and trading.[23] To control for the seasonal effects and for possible effects associated with Fed districts, quarterly dummies and Fed district dummies are added.[24] Four lags of the 6-month paper-bill spread and a lagged COM variable, interacted with four lags of paper-bill spread, are placed in the regression equation, where the variable COM is defined as the ratio of total unused loan commitment to total loans, which measures the intensity of commitment loans in overall loan-making activity.

Following the model's implication and bank-level results, we expect both positive and negative effects of loan commitments. The positive effect stems from additional funding sources provided by loan commitments while the negative effect stems from term loans crowded out by increased loan takedown. Since the model says nothing about which effect prevails more, it would be good to decide after looking at the empirical results. If the former outweigh the latter, we expect $\sum \widehat{\beta}_j < 0$, which can be interpreted as meaning that economic activity with more loan commitments will show less volatility as market liquidity dries up. That is, loan commitments will function so as to dampen liquidity shocks.

For this estimation, OLS and fixed effects panel regression are used. Both fixed effect and GLS random effect models produce the similar estimates and the Hausman test does not reject the null hypothesis of no fixed effects. Hence, results from the GLS random effect model are

[23] Other available industry categories are agriculture, mining and transportation. Adding these industries does not affect the main results.

[24] Using state/time dummies instead of Fed district/quarter dummies does not change the main results.

not reported. In the case of OLS, standard errors are clustered by states to allow for correlation across states. Also, considering the possibility that the assumption of strict exogeneity breaks down, first-differenced GMM (Generalized Methods of Moments) with IV (instrumental variable) are also estimated to address the endogeneity problem.[25] The results of GMM-type IV estimation are presented in the robustness tests below.

3.3.2 Baseline Result

Table 4 reports the results of OLS and fixed effects regression of equation (3) with three output measures: fluctuations of real personal income, real personal income per capita, and employment. The numbers in parentheses are robust standard errors. Panel A gives the results when the 6-month paper-bill spread is used as an indicator of overall market liquidity and Panel B gives the results when the federal funds rate is used instead.[26]

Our main concern is on the sign and the statistical significance of $\sum \beta$, which captures the effect of loan commitments on economic volatility when market liquidity dries up.[27] If loan commitments help stabilize the economy in bad times, we expect this to be negative. The sign of $\sum \beta$ turns out to be negative with high statistical significance in 9 of 12 specifications in Panel A and B. Additionally, note that the direct effect of liquidity shock to economic fluctuations, $\sum \alpha$, is positive in all of the specifications and is statistically significant at the 10 percent level in 7 specifications, which implies that the volatility of real economy increases as financial markets tighten. For example, in the case of real personal income per capita and OLS, it can be

[25] Note that the Hausman test of fixed effect model vs. GLS random effect model is not valid when the assumption of strict exogeneity breaks down. In this regard, we need to use GMM with IVs for the previous bank-level test as well. However, this method is not computationally feasible with more than 300,000 observations.

[26] As more exogenous measure, I also estimate with the Bernanke-Mihov index. The results are not much different from what is reported here.

[27] One might be uncomfortable with using the sum of coefficients, $\sum \alpha$ and $\sum \beta$ over four quarters. I also estimate with one lag and confirm that the main results are maintained. When estimating with one lag, the coefficients get a little bit smaller.

said that economic volatility increases by 0.30 percent as the paper-bill spread widens by one percent. And, for an additional one percent of COM (= loan commitments/assets), it decreases by 0.84 percent. Given the mean value of COM during the sample period at 0.34, we have $0.30 - 0.84 \times COM = 0.30 - 0.84 \times 0.34 = 0.02$. This magnitude is quite noteworthy because the average of economic fluctuation (F) in our sample is 2.34 percent. As the paper-bill spread increases by one percent, real personal income per capita deviates from its time and state average by 0.3 percent and having loan commitments almost offsets liquidity shocks. These results seem to support our argument that loan commitment functions to moderate economic fluctuations during monetary contractions.[28]

In the following section, we will perform various robustness tests including the choices of market liquidity measures, a GMM-type IV model to deal with endogenous/predetermined variables in a panel data model and others.

3.3.3 Robustness Tests

GMM Estimation with Instrumental Variables In the previous analysis, we use OLS and fixed effect panel regressions. One shortcoming of OLS in this context is that it may not properly take into account the individual fixed effects (or unobserved heterogeneity) correlated with regressors, which leads to inconsistency of the OLS estimator. While fixed effect regression removes those individual fixed effects by demeaning variables within each entity, it is likely to create another problem if the covariates violate the assumption of strict exogeneity. Since fixed effect panel regression is just an OLS of the transformed variables which are demeaned within each entity, fixed effect panel regression with predetermined or endogenous variables induces a non-negligible correlation between the transformed error terms and the transformed independent

[28] One concern may arise from the possibility that using the absolute values of the estimated residuals as the dependent variable may affect the asymptotic variances of the estimates that we are interested in, $\sum \alpha_j$ and $\sum \beta_j$, in the second-step regression. To address this problem, the bootstrap method is used and it supports our previous results based on F-statistics. The results are available upon request.

variables.

As Keane and Runkle (1992) argue that panel data models for testing rational expectations using individual-level data do not generally satisfy the strict exogeneity, any panel data model in which each observation is supposed to respond rationally may not fulfill the assumption of strict exogeneity because any current shocks will affect the future values of independent variables. In this regard, we estimate the equation (3) using GMM with instrumental variables. The system GMM is adopted because it is known to deal with the weak instrumental variable problem better than the first differenced GMM.

In principle, we can estimate this system GMM with *all* of the possible instruments to enhance efficiency. We do not attempt to do this. The reasons for not using all of the possible instrument variables are: (1) many instruments are dropped due to collinearity in many cases, (2) the number of instruments may be too large relative to the sample size, and (3) it often fails to converge or delivers unreasonably big or small estimates.[29]

To avoid this overfitting bias, we choose the sixth lag of the ratio of nonperforming loans to total loans (NP) as our instrumental variable, without using subsequent lags, and stack the moment conditions together with the level term conditions. The moment conditions come from $E[NP_{t-6}\Delta u_{it}]$ for $t = 7, 8, ..., T$ and $E[\Delta NP_{t-5}u_{it}]$ for $t = 7, 8, ..., T$, where T is equal to 63 in our sample. The number of instruments is 97 and 115 respectively for the cases of the paper-bill spread and the federal funds rate.

Table 5 gives the result of GMM estimation with IVs of regression equation (3) when the sixth lag of NP_t variable is used as instrumental variables. Two measures of liquidity shock are used and robust standard errors are also provided, which are consistent in the presence of any pattern of heteroskedasticity and autocorrelation within panels.[30] All of the estimates of $\sum \beta_j$

[29] Even in the basic specification, the number of instruments used is more than 100. Arellano and Bond (1998) warns that, in models with endogenous regressors, using too many instruments could result in seriously biased estimates.

[30] The result with the Bernanke-Mihov index is not reported here due to space limitations. In fact, the effect

in Panels A and B display the expected signs and all of the estimates are statistically significant.

The consistency of the GMM estimator depends on the validity of our instruments. Hansen's J-statistics for overidentifying restrictions show that additional moment conditions are valid. In addition, we also look at the serial correlation of first-differenced error terms. In theory, the first-order autocorrelation is expected because $(u_{it} - u_{it-1})$ and $(u_{it-1} - u_{it-2})$ share the term u_{it-1}. In this regard, higher-order autocorrelation in the first-differenced error terms indicates serial correlation in the error term u_{it} itself, which will render some of our instruments invalid. Following this, we test to see if the differenced error term follows $AR(1)$, but not $AR(2)$. In all of the specifications, the Arellano-Bond test for autocorrelation confirms our null hypothesis: the existence of $AR(1)$, but not $AR(2)$.

Alternative Explanations Our model implication comes from bank level and empirical test is performed at the state level. Thus, it is worth verifying that our result is not driven by other balance sheet variables, which are likely to comove with loan commitments. Like loan commitments, other balance sheet variables such as security holdings and bank capital can account for a similar outcome by playing the role of buffer stock to external shocks, thereby preventing the sudden contraction of bank loans.

As Stein (1998) explains, banks with a low buffer stock of liquid assets should be more likely to reduce their lending in response to a monetary tightening. The reason is that banks with a large amount of liquid securities have the option of selling securities to maintain lendings, rather than incurring the cost of issuing CDs.

Van den Heuvel (2002) discusses the possibility of bank capital channel as a monetary policy transmission mechanism. According to his explanation, holding more bank equity can reduce the cost of issuing equity when its capital level is approaching to the regulatory minimum and can serve as a buffer stock to short-term deterioration of profitability.

The ratio of non-performing loans can also be a factor. If a bank maintains its ratio of

of interest is more pronounced when the Bernanke-Mihov index is used.

non-performing loans to total loans at low level, it can be interpreted that the bank is sound in terms of credit risk management or loan quality. Since credit risk tends to be higher during a recession, a bank with a low ratio of non-performing loans possibly faces low credit risk and better protect its loan portfolio. In addition, the ratio of total loans to assets and the ratio of C&I loans to assets are tested because our state-level result can be driven solely by active banking activities in some states. If our loan commitment variable is merely a proxy of financial development or active banking activities, these loan ratio variables may explain our finding.

Taking these possibilities into consideration, I estimate the same regression equation of (3) by replacing the loan commitment variable with these variables in turn. It is equivalent to check if these variables can explain the empirical pattern found in Table 4 and Table 5. Table 6 shows the results from this experiment. While the loan commitment variable is statistically significant with the expected negative sign in all of the estimation methods and output measures, other variables fail to explain the empirical pattern.[31] For example, bank capital ratio, the ratio of security to assets, and the ratio of C&I loans to assets could not produce the expected results in any specifications. While the ratio of total loans to assets shows statistically significant negative signs, these results are not robust to the choices of estimation methods and output measures. It therefore lends further support to the role of loan commitments in our empirical findings.

Hirtle (1990) suggests that loan commitment is a proxy for the share of corporate borrowers who are not bank-dependent, rather than being the actual sources for funds in bad times. Following her explanation, C&I loans may not respond much to the amount of C&I loan commitments outstanding in bad times because firms would seek external funds through issuing commercial papers. In this process, loan commitment is just a signal of firms' financial soundness, which enables them to get funds from *non-bank* sources. If this line of reasoning is correct, our finding becomes a spurious one. However, our bank-level regression shows that the increasing ratio of C&I loans to total loans in bad times is well explained by the amount of loan commitments

[31] The regression results using the paper-bill spread and the Bernanke-Mihov index are not much different from the case of the federal funds rate discussed here.

outstanding. This provides evidence that loan commitment works as an actual source of funds, which becomes more operative during tight periods. More directly, Gatev, Schuermann, and Strahan (2005) show that the observed C&I loan growth during the 1998 crisis was concentrated at banks with high levels of undrawn loan commitments prior to the onset of the crisis. If loan commitment is merely a proxy for firms' ability to secure direct financing, these findings cannot be explained. Thus, though loan commitments can be a proxy for financial market development as Hirtle (1990) suggests, loan commitments have constituted actual sources of funds to firms in bad times.

Outlier States and Sample Periods The reported results are obtained after dropping the states of Delaware and South Dakota.[32] I check to see whether any particular state may be driving our results. The states of interest here are banking- and/or credit card-specific states (New York, Delaware, South Dakota), states with small populations (Alaska, Wyoming), and oil states (Louisiana, Montana, North Dakota, Oklahoma, Texas, Wyoming). As a robustness check, I reestimate the model with multiple combinations. The results reveal that no single state or group drives our results.

In the context in which loan commitments are likely to bolster economic activity in bad times, it appears that gross state product is a better measure of economic activities than state personal income because loan commitments are likely to be more relevant to production activity than they are to income or consumption measure. However, gross state product statistics is available only on a yearly basis, a frequency that is insufficient for analyzing the effect associated with changes in monetary policy stances. As an alternative route, I calculate the percentage deviations of gross state product from state personal income by each year-state and identify which states are different in terms of this measure. The states of Alaska, Wyoming, Delaware and Louisiana are identified as being distinctively different from other states in terms of the

[32] If we estimate with all 50 states (i.e., including Delaware and South Dakota), the regression results are still significant with expected signs. However, the effects of interest are slightly stronger without these two states.

discrepancy between gross product and personal income. Hence, I reestimate the regressions with these states excluded in order to minimize the possible bias from incongruency between the two measures. The results are not much different from the ones reported here.

In terms of sample periods, I check to see if there are any influential periods driving our results. First, I check the effect of the credit crunch in the early 1990s by estimating after dropping observations from 1990:I to 1993:IV. Secondly, by running rolling regressions, I check to see whether the impact of any 4-year period is substantial. I find there is no short period which drives our state-level results.

4 Concluding Remarks

Our bank-level evidence shows that banks with internal capital markets or less limited access to external financing respond differently to increased loan takedown in bad times. I interpret this different response, compared to that of stand-alone banks, as evidence for the existence of a funding effect. It also suggests that a bank which does not want to see its liquidity holding drop to a dangerously low level may reduce its term loans in dealing with liquidity demands from loan commitments.[33] In this regard, loan commitments can be bad for economy since loan commitment takedown tends to crowd out term loans when market liquidity dries up; loan commitments can be good for economy by becoming an additional funding source for those who have access to them. The state-level test tries to answer this empirical question: Do loan commitments help increase economic stability? Our empirical results show that loan commitments lower economic volatility as financial markets tighten, thereby identifying loan

[33] This proposition cannot be interpreted as arguing that term loans are inferior to loans made through loan commitments, however. While loan commitments provide an insurance device by becoming stable sources of funds to firms, term loans serve as another profitable investments for banks because banks can exercise more discretion over them; in this way banks can control disruptions to their financial positions. In this regard, even though the use of loan commitments increases very rapidly in the 1990's, loan commitments are not expected to completely replace term loans in the future.

commitments as one factor contributing to lower financial frictions and less volatile economy.

Our empirical results point to several venues for further exploration. First, considering "loan commitment channel" more seriously will help us to understand firms' liquidity demand patterns and banks' liquidity supply patterns. Previous studies show that large firms/large banks/BHC-affiliated banks tend to respond less sensitively to external shocks compared to small firms/small banks/stand-alone banks (Christiano, Eichenbaum, and Evans (1996), Kashyap and Stein (1995), Ashcraft (2006)). Table 1 reveals that large banks and BHC-member banks issue more loan commitments and it is a well-known fact that large banks are more frequently matched with large firms. Adding further evidence from Morgan (1998) that loans under commitments are unaffected or accelerated after tight policy, this channel may provide a more consistent and comprehensive explanation for the behavior of firms and banks, shedding more light on the transmission mechanism of monetary policy (especially, credit channel). Furthermore, the counter-cyclical property of bank loan commitments can offer a reason for the weak link between loan growth rate and output.

Considering the extensive robustness tests performed in this paper, the bottom line is that loan commitments (more broadly, bank loans) have a close link with overall economic activity. The remaining question is "how?"[34] Addressing the question of how loan commitments actually function within a firm's operation would enhance our understanding of how credit affects the economy. For this purpose, we need more firm-level data linked with more detailed bank balance sheet information (for example, *used* amount of loan commitments).

[34] This paper does not address this question, which is the author's ongoing project.

Appendix

A. Model: How A bank Responds to Increased Takedown

This Appendix develops a variant of the famous "newsboy problem" in operation research literature. Like a newsboy who needs to order the optimal number of newspapers from his/her supplier in the face of uncertain demand, the amount of liquidity held by a bank is treated as inventory for uncertain liquidity demand. Thus, in the context of optimal inventory management, a bank that seeks to maximize its expected net income should consider the optimal amount of liquidity to be held in preparation for stochastic loan takedown while issuing term loans and loan commitments for profitable investments.

The model highlights the determinants of using loan commitments.[35] The simple case will show how the optimal amount of loan commitments is affected by the relative agency costs in capital markets, the degree of uncertainty in borrowers' liquidity demands and other parameters. Following that, an extended version allows a bank to use the option of recalling term loans. When the amount of liquidity held inside falls short of the realized takedown from loan commitments, a bank needs to make up for the shortfall. In this situation, the options open to a bank are (1) to get uninsured funds through external financing and (2) to reduce the amount of term loans to be issued. The relative importance of these two options depends on their relative marginal costs. If a bank's external financing cost is higher compared to that of others, it will cut down more of its term loans if other things are equal. This extended version will show that the ratio of loan commitments to term loans will increase in bad times and this effect is stronger for small banks or stand-alone banks, which suffer from high agency costs in external financing. This prediction is tested in the body of this paper.

A.1. Simple Case

The one-period model is designed to capture the following characteristics of a bank in a minimalist fashion: (1) a bank provides funds to its customers via term loans (N) or commitment

[35] The framework is similar to the one in Kashyap, Rajan, and Stein (2002). Their focus is more on the synergy effect in saving liquidity by dealing with loan commitments and demand deposits under one roof.

loans (C); and (2) it should maintain a buffer stock of liquid assets (S) inside to meet the unexpected takedown of loan commitment; but (3) it is costly for a bank to raise external finance in the event that the amount of takedown is larger than the buffer stock of liquidity. In this setting, a bank faces the problem of liquidity management. If it amasses too much liquidity inside, it loses more profitable investment opportunities through term loans or commitment loans. However, it incurs the penalty of more expensive external financing when the expected level of liquidity falls short of the realized takedown.

In the beginning of the period (period 0), a bank is endowed with deposit D, which is to be optimally divided into term loans and commitment loans. A bank can make profits by issuing term loans with the rate of r_N and loan commitments. When a bank issues loan commitments, it receives a total contract fee $f(C)C$ where $f(C) = j - hC$ $(j, h > 0)$ and earns r_C per unit of realized takedown.[36] The actual takedown will be determined by a random variable $z \in [0, 1]$, which is realized following a bank's portfolio decision. We assume that z is uniformly distributed in the range of $[a, b]$ where $0 \leq a < b \leq 1$.[37] The difference between term loans and loan commitments is that, in the case of the latter, a bank must address the uncertainty of how much of funds will be taken down due to loan commitment. If it fails to meet the realized takedown (zC) with the predetermined buffer stock (S_0), it should raise external finance as much as $B = \max[zC - S_0, 0]$ at the end of the period (period 1). In order to get a closed-form solution, cost function takes the simple form of $H(B) = \alpha(zC - S_0)$ when $zC > S_0$ with properties of $H'(B) > 0$ and $H(0) = 0$.[38] It is reasonable to assume $\alpha > r_N$ since α can be interpreted as the

[36] According to Ergungor (2001), the fee structure may include a commitment fee, which is an up-front fee paid when the contract is made; an annual service fee, which is paid on the borrowed amount; and a usage fee, which is levied on the unused amount. I assume that only a commitment fee is charged.

[37] In fact, more complicated and realistic distributions such as beta distribution can be used without changing the main results. However, we focus on this simple case to get closed-form solutions.

[38] Stein (1998) derives a quadratic form of cost function in a more formal model where there is an adverse selection problem in a bank's uninsured liabilities. When we use a quadratic form, our main results are not affected. However, closed-form solutions are not available in this case.

penalty cost of external financing that is incurred when it fails to predict the loan commitment takedown correctly. In addition, the parameter α measures the degree of adverse selection problem a bank faces in the capital markets. Thus, we expect α to be decreasing with bank size because larger banks tend to suffer less from capital market imperfections.

A bank seeks to maximize its expected net income:

$$\max_{C,S_0} .E[r_N N + f(C)C + r_C zC - H(B)]$$

subject to

$$N + S_0 = D \tag{4}$$

$$N + zC + S_1 = D + B \tag{5}$$

and

$$S_1 = \max\{S_0 - zC, 0\} \tag{6}$$

where equation (4) and (5) are balance sheet constraints for period 0 and 1 respectively. If the period 0 liquidity (S_0) is not sufficient for the takedown, additional funds need to be obtained, but not through short sales. This is reflected in (6). Since external financing is necessary only when $zC > S_0$, the expected external financing cost function is given by

$$\begin{aligned} E[H(B)] &= \int_a^b \alpha(zC - S_0)dF(z) \\ &= \alpha \int_{S_0/C}^b (zC - S_0)dF(z) + \alpha \int_0^{S_0/C} 0dF(z) \\ &= \alpha \int_{S_0/C}^b (zC - S_0)dF(z) \end{aligned}$$

Reformulating the maximization problem gives:

$$\max_{C,S_0} .E[r_N(D - S_0) + (j - hC)C + zr_C C] - \alpha \int_{S_0/C}^b (zC - S_0)dF(z)$$

The first order conditions are

$$[C] : r_C\mu_z + j - 2hC^* = \frac{\alpha}{2}(b^2 - \frac{S_0^{*2}}{C^{*2}})$$

$$[S_0] : r_N = \alpha(b - \frac{S_0^*}{C^*})$$

where μ_z is the mean value of z. These two first order conditions consist of a non-linear simultaneous equation system for the optimal level of loan commitment and liquidity to be maintained. By rearranging and solving for C^* and S_0^*, we obtain:

$$C^* = \frac{1}{2h}[\frac{r_N^2}{2\alpha} - r_N b + r_C \mu_z + j]$$

$$S_0^* = \frac{\alpha b - r_N}{\alpha} C^*$$

And the optimal amount of term loans N^* is then determined with S_0^* in (4).

The comparative statics for some variables of interest reveals very intuitive results. The first result concerns the effect of external financing ability on loan commitments. As shown in (7),

$$\frac{\partial C^*}{\partial \alpha} = -\frac{r_N^2}{4h\alpha^2} < 0 \tag{7}$$

a bank with high agency cost in the capital markets (higher α banks) tends to issue less amount of loan commitments.

As one characteristics of the demand side, it would be interesting to see the effect of uncertain takedown on loan commitment issuance. Letting $b \equiv b' + \varepsilon$ and $a \equiv a' - \varepsilon$, increasing ε is equivalent to increasing the variance of z leaving its mean unchanged. The second comparative statics shows

$$\frac{\partial C^*}{\partial \varepsilon} = -\frac{r_N}{2h} < 0$$

which implies that a bank with more uncertain liquidity demand from loan commitments tends to rely less on loan commitments. This explains why many banks impose usage fees. Charging usage fees on the amount of *unused* loan commitments helps a bank to better predict the actual amount of loan takedown and manage liquidity with more ease, narrowing the distance between a and b.

As to the optimal amount of liquidity held inside for unexpected takedown, there are two opposing forces. Higher external financing costs (higher α) force a bank to hold more liquidity given C^* and also deter a bank from issuing loan commitments, leading to less demand for liquidity. (8) reflect this intuition[39]:

$$\frac{\partial S_0^*}{\partial \alpha} = (1 - \frac{r_N}{\alpha})\frac{\partial C^*}{\partial \alpha} + \frac{r_N}{\alpha^2}C^* \lesseqgtr 0 \tag{8}$$

However, if the cost of external financing is so exorbitantly high that it is practically impossible to get funds from outside, a bank should amass liquidity equal to the maximum amount of takedown, as shown in (9):

$$\lim_{\alpha \to \infty} S_0^* = bC^* \tag{9}$$

While it is possible to perform the comparative statics with all of the parameters in the model, the first result provides our first prediction. for empirical analysis.

Proposition 1 *A bank with low agency cost in capital markets or with cheaper sources of external funds will issue more loan commitments. Following our notations, $\partial C^*/\partial \alpha < 0$.*

The above proposition implies that larger banks, which face less adverse selection problems in capital markets, and BHC-affiliated banks, which have internal capital markets, are expected to issue more loan commitments compared to smaller and stand-alone banks.

A.2. Model with Recallable Term Loans

We'll extend the previous model by allowing a bank to recall its term loans. When there is a liquidity shortage, a bank is allowed to cancel part of its term loans which are initially planned (N_0). When recalling its term loans by the amount of ($N_0 - N_1$), it incurs the cost of $G(N_0 - N_1)$.[40] $G(\cdot)$ entails forgone interest income and reputation cost. N_0 can be regarded as the optimal amount of term loans before takedown shock (z) is realized while N_1 is the optimal

[39] If the response of loan commitments is not too negative, we expect $\partial S_0^*/\partial \alpha$ to be positive. More formally, a sufficient condition for $\partial S_0^*/\partial \alpha > 0$ is

$$\frac{r_N}{(r_N - 1)} < \frac{\partial C^*/\partial \alpha}{C^*/\alpha} < 0$$

That is, it says that the elasticity of C^* to α is not too negative.

[40] In the model, we implicitly assume that the cost of negating the legal obligation by invoking MAC (Material

amount of term loans actually issued at period 1 after the realization of z between period 0 and 1.

A bank's maximization problem is:

$$\max . E[r_N N_0 + f(C)C + r_C zC - H(B) - G(N_0 - N_1)]$$

subject to

$$N_0 + S_0 = D$$

$$N_1 + zC + S_1 = D + B$$

and

$$S_1 = \max\{S_0 - zC, 0\}$$

If liquidity held inside can meet the demand from takedown, there is no need for external financing or recalling term loans. In this case, N_1 is equal to N_0. If not, the excessive amount of liquidity demand, $\Delta \equiv (zC - S_0)$, should be dealt with by means of external financing and by reducing the term loans to be issued. That is, when $zC > S_0$, it should be

$$\Delta \equiv zC - S_0 = B + (N_0 - N_1)$$

Alternatively,

$$N_1 = \min\{N_0, D + B - zC\}$$

Since this cost associated with external financing and recalling term loans arises only when $\Delta > 0$, we can think of a cost minimization problem for a given amount of excess demand Δ first and expect the minimized cost function to be a function of Δ. Regarding the realized $\Delta > 0$ as

Adverse Change) clauses or using covenants on borrowers' profitability is infinite. However, as Sufi (2007) shows, loan commitments tend to be more flexible than our expectations and they are extended following the close monitoring by banks. Nevertheless, an assumption that the cost of canceling loan commitments is higher than that of cutting term loans is sufficient for our model's implication to bear out.

a constant, we face the problem of optimally dividing excess demand (Δ) into borrowing (B) and cutting term loans ($N_0 - N_1$):

$$\min_{B,N_1} .H(B) + G(N_0 - N_1)$$

subject to

$$\Delta = B + (N_0 - N_1)$$

Assuming $H(B) = \alpha B$ and $G(N_0 - N_1) = \gamma(N_0 - N_1)^2$ gives the closed form solutions of the optimal levels of external financing and the amount of term loans to be cut down.[41] They are:

$$B^* = \Delta - \alpha/2\gamma \quad \text{and} \quad N_0^* - N_1^* = \alpha/2\gamma \quad \text{if } \Delta > 0 \tag{10}$$

where α is the marginal cost for external borrowing and γ is a measure of relative costs associated with cutting term loans. Plugging these into the objective function gives the minimized expected cost function. Considering that this optimized function is relevant only when $\Delta > 0$, our original problem becomes

$$\max_{C,S_0} .E[r_N(D - S_0) + fC + r_C zC] - \alpha \int_{S_o/C}^{1} (zC - S_0)dF(z) - \frac{\alpha^2}{4\gamma}(1 - \frac{S_0}{C})$$

assuming $z \in [0, 1]$ for simplicity. This can be solved by differentiating with respect to C and S_0 as in the previous section, though the closed form solutions are not available in this case. Our concern is to see how much of the term loans are reduced in response to tightened financial constraints caused by increased loan takedown. Since Δ is to be optimally divided between B and $N_0 - N_1$ when $\Delta > 0$, the amount of term loans that are reduced depends on the marginal costs of external financing and recalling term loans. As a result, B^* and $(N_0^* - N_1^*)$ are functions of α and γ, and $(N_0^* - N_1^*)$ is an increasing function of α, as shown in (10).

[41] Assuming both $H(\cdot)$ and $G(\cdot)$ are quadratic, we have

$$B^* = \frac{\alpha}{\alpha + \gamma}\Delta \quad \text{and} \quad N_0^* - N_1^* = \frac{\gamma}{\alpha + \gamma}\Delta \quad \text{when } \Delta > 0$$

Except for one special case in which both $H(\cdot)$ and $G(\cdot)$ are linear, both B^* and $N_0 - N_1^*$ are functions of α.

The results imply that, for a given amount of Δ, a bank with higher α will recall more of its term loans because its ability to acquire external financing is more limited. Following this, one testable empirical implication is derived. In bad times when firms find it harder to get external funds, takedown from loan commitments (zC) increases and causes banks to cut down its term loans ($N_0 - N_1$) in an attempt to readjust their portfolios.[42] Therefore, the ratio of loans made through commitment arrangements to term loans increases and this effect is expected to be bigger, the higher the amount of outstanding loan commitments. Let R be the ratio of loans made through commitment contracts to term loans. Then we expect:

$$\frac{\partial^2 R}{\partial M \partial C} > 0 \tag{11}$$

and

$$\frac{\partial^3 R}{\partial M \partial C \partial \alpha} > 0$$

where M is a measure of economy-wide liquidity with higher values corresponding to higher paper-bill spread and higher loan takedown shock z in the model.

Proposition 2 *In a bank's loan portfolio, the ratio of loans made under commitment to term loans increases with the amount of loan commitment outstanding in bad times ($\partial^2 R/\partial M \partial C > 0$). Further, this effect is more pronounced for smaller banks and stand-alone banks ($\partial^3 R/\partial M \partial C \partial \alpha > 0$).*

The proposition says that the ratio of commitment loans to term loans will increase during recessions due to increased loan takedown. This effect will be stronger for banks with more limited ability to tap uninsured funds because the amount of term loans crowded by commitment loans is bigger for these banks. Extending this implication, it can be interpreted that borrowers

[42] I implicitly assume that high z corresponds to the times when financial markets are tight. This can be justified by the empirical results in Morgan (1998), in which he shows that loan takedown tends to increase in bad times.

of loan commitments and term loans are disproportionately affected by external shocks. This implication is tested in the body of this paper.

B. Definition of Variables

All bank balance sheet variables are available at the Federal Reserve Bank of Chicago website (http://www.chicagofed.org). Whenever available, I follow the definitions in Kashyap and Stein (2000), Campello (2002) and Ashcraft (2006).

Assets. Total assets are taken from RCFD2170.

Total loans. The item RCFD2125 (total loans, net of unearned income) is used for total loans.

Balance. This variable is defined as the ratio of security to total assets. The amount of security a bank holds is defined as RCFD0390 (securities, book value) plus RCFD1350 (federal funds sold) up until 1993:IV. After that, it is the sum of RCFD1754 (held-to-maturity securities, total), RCFD1773 (available-for-sale securities, total), and RCFD1350.

Non-performing loans. Following the definition used in Campello (2002), it equals the ratio of RCFD1407 (loans over 90 days late), plus RCFD1403 (loans not accruing), to total loans.

Commitments. For total unused commitments, the item RCFD3423 is used, which is available for 1983:II-1999:IV. This measure is equal to the sum of RCFD3814 (revolving, open-end lines secured by 1-4 residential properties, e.g. home equity lines), RCFD3815 (credit card lines), RCFD3816 (commitment to fund loans secured by real estate), RCFD3817 (securities underwriting), RCFD3818 (other unused commitments), and RCFD6650 (commitment to fund loans not secured by real estate) from 1991:I.

Industry labor income shares. The data is obtained from the Bureau of Economic Analysis website (http://www.bea.doc.gov). I use the nine industry codes: 100 = agricultural services, forestry, fishing and other, 200 = mining, 300 = construction, 400 = manufacturing, 500 = transportation and public utilities, 610 = wholesale trade, 620 = retail trade, 700 = finance, insurance, and real estate, 800 = services, 900 = government and government enterprises. For trade industry, it is the sum of wholesale and retail trade. To get labor income shares, all industry incomes are divided by non-farm earnings (code = 82).

References

Arellano, M., and S. Bond (1998): "Dynamic Panel Data Estimation Using DPD98 for Gauss: A Guide for Users," *mimeo.*

Ashcraft, A. (2006): "New Evidence on the Lending Channel," *Journal of Money, Credit and Banking*, 38.

Avery, R., and A. Berger (1991): "Loan Commitments and Bank Risk Exposure," *Journal of Banking and Finance*, 15, 173–192.

Boot, A. W. A., and A. Thakor (1991): "Off-balance Sheet Liabilities, Deposit Insurance and Capital Regulation," *Journal of Banking and Finance*, 15, 825–846.

Campello, M. (2002): "Internal Capital Markets in Financial Conglomerates: Evidence from Small Bank Responses to Monetary Policy," *Journal of Finance*, 57(6), 2773–2805.

Chava, S. (2004): "Modeling Loan Commitments and Liquidity Crisis: Theory and Estimation," *mimeo.*

Christiano, L. J., M. Eichenbaum, and C. L. Evans (1996): "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics*, 78, 16–34.

Dynan, K. E., D. W. Elmendorf, and D. E. Sichel (2006): "Can Financial Innovation Help to Explain the Reduced Volatility of Economic Activity?," *Journal of Monetary Economics*, 53, 123–150.

Edelstein, P. (1991): "Effective Letters of Intnent and Commitment Letters," *Journal of Commercial Bank Leding*, 73(6-16).

Ergungor, O. E. (2001): "Theories of Bank Loan Commitments," *Economic Review*, 37(3), Federal Reserve Bank of Cleveland.

Gatev, E., T. Schuermann, and P. E. Strahan (2005): "How Do Banks Manage Liquidity Risks?: Evidence from Equity and Deposits Markets in the Fall of 1998," *NBER Working Paper 10982*.

——— (2006): "Managing Bank Liquidity Risk: How Deposit-Loan Synergies Vary with Market Conditions," *Review of Financial Studies*.

Gatev, E., and P. E. Strahan (2006): "Banks' Advantage in Hedging Liquidity Risks: Theory and Evidence from the Commercial Paper Market," *Journal of Finance*.

Hirtle, B. (1990): "Loan Commitments and the Transmission of Monetary Policy," *Financial Changes and the Transmission of Monetary Policy*.

Kashyap, A. K., R. Rajan, and J. C. Stein (2002): "Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking," *Journal of Finance*, (1).

Kashyap, A. K., and J. C. Stein (1995): "The Impact of Monetary Policy on Bank Balance Sheets," *Carnegie-Rochester Conference Series on Public Policy*, 42, 151–195.

——— (2000): "What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?," *American Economic Review*, 90(3), 407–428.

Keane, M. P., and D. E. Runkle (1992): "On the Estimation of Panel Data with Serial Correlation When Instruments Are Not Strictly Exogenous," *Journal of Business and Economic Statistics*, 10.

KIM, C., J. PIGER, AND C. R. NELSON (2004): "The Less Volatile U.S. Economy: A Bayesian Investigation of Timing, Breadth, and Potential Explanations," *Journal of Business and Economic Statistics.*

MCCONNELL, M., AND G. PEREZ-QUIROS (2000): "Output Fluctuations in the United States: What Changed Since the Early 1980's?," *American Economic Review*, pp. 1464–1476.

MORGAN, D. P. (1993): "Financial Contracts When Costs and Returns Are Private," *Journal of Monetary Economics*, 31, 129–146.

——— (1998): "The Credit Effects of Monetary Policy: Evidence Using Loan Commitments," *Journal of Money, Credit and Banking*, 30(1), 102–118.

MORGAN, D. P., B. RIME, AND P. E. STRAHAN (2004): "Bank Integration and State Business Cycle," *Quarterly Journal of Economics.*

MORRIS, C. S., AND G. H. SELLON (1995): "Bank Lending and Monetary Policy: Evidence on a Credit Channel," *Economic Review*, Federal Reserve Bank of Kansas City.

PARK, K. Y. (2006): "A Model of Bank Asset and Liability Management with Loan Commitments," *University of Chicago Ph.D. Dissertation.*

SHOCKLEY, R. L., AND A. V. THAKOR (1997): "Bank Loan Commitment Contracts: Data, Theory, and Tests," *Journal of Money, Credit and Banking*, 29(4).

SOFIANOS, G., P. WACHTEL, AND A. MELNIK (1990): "Loan Commitments And Monetary Policy," *Journal of Banking and Finance*, 14, 677–689.

STEIN, J. C. (1998): "An Adverse Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy," *RAND Journal of Economics*, 29, 466–486.

STOCK, J., AND M. W. WATSON (2002): "Has the Business Cycle Changed and Why?," *NBER Macroeconomics Annual 2002*.

SUFI, A. (2007): "Bank Lines of Credit in Corporate Finance: An Empirical Analysis," *Review of Financial Studies*.

TAYLOR, J. (2000): "Recent Changes in Trend and Cycle," *mimeo*.

VAN DEN HEUVEL, S. J. (2002): "The Bank Capital Channel of Monetary Policy," *mimeo*.

Table 1 - Descriptive Statistics

All of the variables are defined as the ratio to bank total assets, except for the number of banks (line 1), nonperforming loans (line 7), and commitment/loan (line 12). Nonperforming loans are defined as the ratio of loans over 90 days late, plus loans not accruing, to total loans. Commitment/loan is defined as the ratio of total unused commitment to total loans. The numbers are median values in each size/BHC (Bank Holding Company)-affiliation categories. 'Large' banks are in the top 1 percent in terms of average assets during the sample period and 'small' banks refer to ones in the bottom 95 percent. Some exclusion criteria, discussed in the text, are applied to remove outliers in the sample. Source: author's calculation based on Call Reports.

year	1985Q1					1999Q4				
size/membership of BHC	large	medium/ BHC	medium/ stand-alone	small/ BHC	small/ stand-alone	large	medium/ BHC	medium/ stand-alone	small/ BHC	small/ stand-alone
1. number of banks	130	462	56	7834	5221	75	213	15	6213	1627
2. cash	0.137	0.090	0.073	0.063	0.064	0.049	0.038	0.022	0.045	0.050
3. security + cash	0.302	0.343	0.390	0.396	0.451	0.262	0.304	0.414	0.330	0.385
4. total loans	0.624	0.613	0.561	0.556	0.506	0.653	0.645	0.522	0.626	0.575
5. C&I loans	0.229	0.187	0.173	0.131	0.093	0.166	0.121	0.107	0.070	0.079
6. loans to individuals	0.113	0.131	0.128	0.106	0.112	0.076	0.071	0.017	0.067	0.063
7. nonperforming loans	0.023	0.015	0.017	0.021	0.020	0.007	0.006	0.006	0.005	0.005
8. total deposits	0.754	0.854	0.882	0.896	0.888	0.670	0.738	0.785	0.863	0.864
9. transaction deposits	0.218	0.233	0.227	0.219	0.212	0.114	0.128	0.039	0.236	0.238
10. demand deposits	0.166	0.172	0.164	0.131	0.127	0.094	0.096	0.025	0.116	0.125
11. equity	0.057	0.064	0.070	0.079	0.092	0.079	0.076	0.094	0.088	0.107
12. commitment/loan	0.374	0.015	0.048	0	0	0.509	0.278	0.240	0.130	0.104

Table 2. Increased Loan Takedown Crowds Out Term Loans in Bad Times: OLS Regression

This table reports bank-level OLS regression coefficients from equation (1). The standard errors are clustered by state and the numbers in parentheses are p-values. The estimated equation is

$$R_{it} = c + \sum_{j=1}^{4} \alpha_j M_{t-j} + \sum_{j=1}^{4} \beta_j M_{t-j} COM_{i,t-1} + \sum_{j=1}^{4} \gamma_j M_{t-j} COM_{i,t-1} BHC_i$$
$$+ \text{(bank balance sheet variables)} + \text{(dummy variables)} + u_{it}$$

where R_{it} is the share of C&I loans to total loans, M_t is the 6-month paper-bill spread as a measure of market-wide liquidity, COM_{it} is the share of C&I loan commitments to total loans, and BHC_i takes one if a bank is BHC-affiliated. Bank balance sheet variables include log of assets, shares of liquidity, non-performing loans, loan commitments, transaction deposits and equities to assets. Dummy variables are dummies for time, eight Fed districts, quarter, credit crunch period of 1990-1993, and BHC-affiliation. The sample size is 279,187 and the number of clusters is 11,959.

	Specification				
Sums of Coefficients on	(1)	(2)	(3)	(4)	(5)
Market-wide liquidity	0.51	0.15	0.97	0.76	0.55
	(0)	(0)	(0)	(0)	(0)
(Market-wide liquidity)**COM*	10.46	10.05	4.57	4.11	4.44
	(0)	(0)	(0)	(0)	(0)
(Market-wide liquidity)**COM*BHC*	-4.44	-4.55	-4.85	-4.17	-4.21
	(0)	(0)	(0)	(0)	(0)
Bank B/S variables	No	No	Yes	Yes	Yes
Time dummy	No	Yes	No	No	Yes
Fed-district dummy	No	Yes	No	Yes	Yes
Quarterly dummy	No	Yes	No	Yes	Yes
Dummy for credit crunch	No	Yes	No	Yes	Yes
Dummy for BHC	No	Yes	No	Yes	Yes
R^2	0.05	0.09	0.10	0.12	0.12

Table 3. Increased Loan Takedown Crowds out Term Loans in Bad Times: Robustness Check

Panel A reports bank-level OLS regression coefficients from equation (1) and Panel B reports fixed effect panel regression of equation (1). Specification (5) in Table 2 is used. The standard errors are clustered by state and the numbers in parentheses are p-values. The estimated equation (1) is

$$R_{it} = c + \sum_{j=1}^{4} \alpha_j M_{t-j} + \sum_{j=1}^{4} \beta_j M_{t-j} COM_{i,t-1} + \sum_{j=1}^{4} \gamma_j M_{t-j} COM_{i,t-1} BHC_i$$
$$+ \text{(bank balance sheet variables)} + \text{(dummy variables)} + u_{it}$$

In the case of panel regression, the error term includes bank fixed effects. The 6-month paper-bill spread and the federal funds rate are used for the market-wide liquidity measure, M_t. Well-capitalized banks refer to banks whose equity ratio ranges from 6% to 15%. The sample period is 1990:I-1997:II for the 6-month paper-bill spread and 1990:I-1999:IV for the federal funds rate.

Panel A: OLS Regression with Standard Errors Clustered by State

	Measure of Market-Wide Liquidity	
	6-Month PB Spread	Federal Funds Rate
1. Small Banks		
Market-wide liquidity	0.55	0.66
	(0)	(0)
(Market-wide liquidity)**COM*	4.44	2.71
	(0)	(0)
(Market-wide liquidity)**COM*BHC*	-4.21	-2.91
	(0)	(0)
Sample size	279,187	347,108
R^2	0.12	0.12
2. Small Banks, Well Capitalized		
Market-wide liquidity	0.55	0.61
	(0)	(0)
(Market-wide liquidity)**COM*	4.54	3.11
	(0)	(0)
(Market-wide liquidity)**COM*BHC*	-4.90	-3.59
	(0)	(0)
Sample size	251,027	312,131
R^2	0.12	0.12

Panel B: Fixed Effect Regression with Robust Standard Errors

	Measure of Market-Wide Liquidity	
	6-Month PB Spread	Federal Funds Rate
1. Small Banks		
Market-wide liquidity	0.39	0.47
	(0)	(0)
(Market-wide liquidity)**COM*	2.76	1.45
	(0)	(0)
(Market-wide liquidity)**COM*BHC*	-1.26	-0.96
	(0)	(0)
Sample size	279,187	347,108
R^2 (within)	0.05	0.05
2. Small Banks, Well Capitalized		
Market-wide liquidity	0.38	0.05
	(0)	(0)
(Market-wide liquidity)**COM*	2.80	1.60
	(0)	(0)
(Market-wide liquidity)**COM*BHC*	-1.47	-1.16
	(0)	(0)
Sample size	251,027	312,131
R^2 (within)	0.05	0.04

Table 4. Loan Commitments Help Stabilize the Economy in Bad Times

Panel A reports state-level OLS and fixed effects panel regression coefficients of equation (3) when the 6-month paper-bill spread is used as a measure of market-wide liquidity. Panel B reports the coefficients when the federal funds rate is used. The estimated equation (3) is

$$F_{it} = c + \sum_{j=1}^{4} \alpha_j M_{t-j} + \sum_{j=1}^{4} \beta_j M_{t-j} COM_{i,t-1} + \sum_{j=1}^{6} \phi_j IS_{i,t-1}^{j}$$
$$+(\text{bank balance sheet variables}) + (\text{dummy variables}) + u_{it}$$

where F_{it} is a measure of economic fluctuations, M_t is a measure of market-wide liquidity, COM_t is a share of loan commitments to total loans, and $IS_{i,t}^{j}$ is the *j* th industry share of state *i*. Bank balance sheet variables are aggregated to state-level. Dummy variables include quarterly, Fed-district, and credit crunch period of 1990-1993. P-values, based on robust standard errors, are in parentheses. * significant at 10 percent and ** significant at 5 percent.

Panel A: Market-wide Liquidity Measure (M) – 6-Month Paper-Bill Spread

	Dependent Variable: Fluctuations of Output Measure (N = 2,352)		
	Real Personal Income	Real Personal Income per Capita	Employment
1. OLS			
Market-wide liquidity	0.28**	0.30**	0.21
	(0.04)	(0.04)	(0.36)
(Market-wide liquidity)**COM*	-0.82**	-0.84**	-0.31
	(0.04)	(0.04)	(0.77)
R^2	0.15	0.15	0.25
2. Fixed Effects			
Market-wide liquidity	0.29*	0.32*	0.18
	(0.10)	(0.07)	(0.33)
(Market-wide liquidity)**COM*	-0.80*	-0.83*	0.39
	(0.08)	(0.07)	(0.62)
R^2 (within)	0.10	0.10	0.07

Panel B: Market-wide Liquidity Measure (M) – Federal Funds Rate

	Dependent Variable: Fluctuations of Output Measure (N = 2,784)		
	Real Personal Income	Real Personal Income per Capita	Employment
1. OLS			
Market-wide liquidity	0.11	0.12*	0.51*
	(0.13)	(0.10)	(0.09)
(Market-wide liquidity)**COM*	-0.67**	-0.67**	-1.53
	(0.01)	(0.01)	(0.15)
R^2	0.15	0.14	0.27
2. Fixed Effects			
Market-wide liquidity	0.09	0.13	0.66**
	(0.35)	(0.22)	(0.01)
(Market-wide liquidity)**COM*	-0.63**	-0.65**	-1.63**
	(0.03)	(0.02)	(0.06)
R^2 (within)	0.10	0.10	0.09

Table 5. Loan Commitments Help Stabilize the Economy in Bad Times: GMM with IVs

This table reports the coefficients of equation (3) using the system GMM with instrumental variables. Robust standard errors are used, which are consistent in the presence of any pattern of heteroskedasticity and autocorrelation within panels. J-statistics from Hansen's overidentifying restrictions are reported with p-values. P-values from testing autocorrelation of *AR*(1) and *AR*(2) in first-differenced error terms are also reported. * significant at 10 percent and ** significant at 5 percent.

Panel A: Market-wide Liquidity Measure (M) – 6-Month Paper-Bill Spread

	Dependent Variable: Fluctuations of Output Measure (*N* = 2,352)		
	Real Personal Income	Real Personal Income per Capita	Employment
Market-wide liquidity	0.61**	0.65**	-1.06
	(0.05)	(0.04)	(0.15)
(Market-wide liquidity)**COM*	-1.74*	-1.79*	6.24*
	(0.09)	(0.08)	(0.06)
Hansen's J-statistics (p-values)	25.52 (1)	33.72 (1)	40.42 (0.99)
Arellano-Bond test for *AR*(1)	(0.00)	(0.00)	(0.01)
Arellano-Bond test for *AR*(2)	(0.36)	(0.29)	(0.93)

Panel B: Market-wide Liquidity Measure (M) – Federal Funds Rate

	Dependent Variable: Fluctuations of Output Measure (N = 2,784)		
	Real Personal Income	Real Personal Income per Capita	Employment
Market-wide liquidity	0.41	0.42	3.19
	(0.21)	(0.17)	(0.00)
(Market-wide liquidity)**COM*	-1.76*	-1.73*	-7.62**
	(0.06)	(0.06)	(0.00)
Hansen's J-statistics (p-values)	27.86 (1)	27.79 (1)	38.80 (1)
Arellano-Bond test for *AR*(1)	(0.00)	(0.00)	(0.01)
Arellano-Bond test for *AR*(2)	(0.35)	(0.26)	(0.31)

Table 6. Other Bank Balance Sheet Variables Fail to Replace the Role of Loan Commitments

This table displays the results from estimating equation (3) by replacing loan commitments (*COM*) with other bank balance sheet variables in order to see if the empirical pattern in Tables 4 and 5 can be explained by other variables. Loan commitments and bad Loans are used as a share to total loans. Other variables are used as a share to assets. The federal funds rate is used as a measure of market-wide liquidity. FE refers to fixed effects panel regression and GMM-IV is the system GMM with instrumental variables. P-values are in parentheses. † denotes coefficients with the expected negative sign as well as statistical significance at the 10% level.

	Candidate Variables					
	Loan Commitments	Equity	Security	Bad Loans	Total Loans	C&I Loans
1. Real Personal Income						
OLS	-0.67†	2.52	0.47	-1.14	-0.49	0.31
	(0.01)	(0.40)	(0.39)	(0.79)	(0.40)	(0.42)
FE	-0.63†	3.79	0.46	-4.02	0.26	-0.04
	(0.03)	(0.33)	(0.48)	(0.92)	(0.57)	(0.95)
GMM-IV	-1.76†	-9.65	-1.72	12.79	3.33	5.55
	(0.06)	(0.21)	(0.48)	(0.18)	(0.14)	(0.02)
2. Real Personal Income Per Capita						
OLS	-0.67†	3.08	0.62	-0.28	-0.53	0.38
	(0.01)	(0.20)	(0.28)	(0.95)	(0.37)	(0.32)
FE	-0.65†	4.04	0.54	-3.21	0.17	-0.02
	(0.02)	(0.31)	(0.42)	(0.48)	(0.72)	(0.97)
GMM-IV	-1.73†	-7.67	-1.09	9.71	3.21	5.51
	(0.06)	(0.31)	(0.66)	(0.31)	(0.16)	(0.02)
3. Employment						
OLS	-1.63†	-29.23	-2.08	11.47	-2.39	-1.12
	(0.06)	(0.23)	(0.42)	(0.46)	(0.28)	(0.74)
FE	-1.53	-10.05	-1.09	20.10	0.78	-0.04
	(0.15)	(0.48)	(0.60)	(0.12)	(0.59)	(0.98)
GMM-IV	-7.62†	11.23	17.36	-46.27	-16.34†	-9.32
	(0.00)	(0.82)	(0.05)	(0.50)	(0.03)	(0.21)

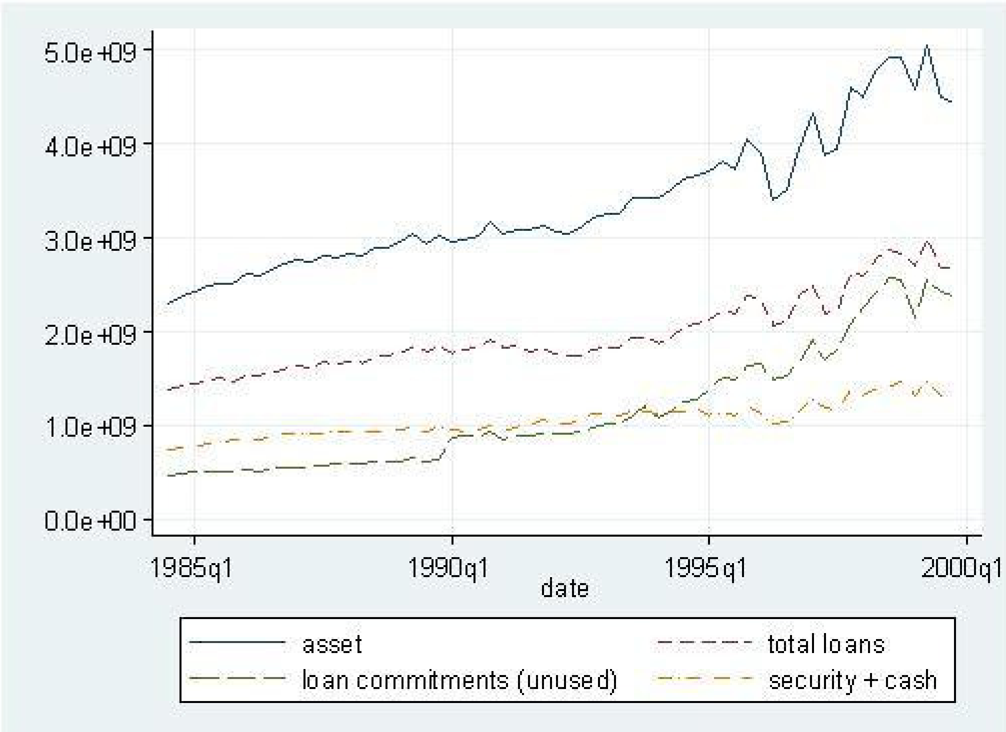

Figure 1: Increased Use of Bank Loan Commitments (units: thousand dollars)