BORROWERS' FINANCIAL CONSTRAINTS AND THE TRANSMISSION OF MONETARY POLICY: EVIDENCE FROM FINANCIAL CONGLOMERATES

Abstract

Building on recent evidence concerning the functioning of internal capital markets in financial conglomerates, we conduct a novel test of the balance-sheet channel of monetary policy. Specifically, we investigate how the response of lending to monetary policy differs across small banks that are affiliated with the same bank holding company but operate in distinct geographical areas. These banks face similar constraints in accessing internal and external sources of funds, but have different pools of borrowers. Because they typically concentrate their lending with small local businesses, we can exploit cross-sectional differences in local economic indicators at the time of a policy shock to study whether the strength of borrowers' balance sheets affects the response of bank lending. We find evidence that the negative response of bank loan growth to a monetary contraction is significantly stronger when borrowers have weaker balance sheets.

JEL Codes: E50, E51, G22. **Keywords:** monetary policy, balance sheet channel, financial conglomerates, internal capital markets.

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1 Introduction

How does monetary policy affect the real economy? One of the main empirical puzzles motivating current research on monetary policy how small and transitory changes in short-term interest rates drive a strong and lagged reaction of the real economy. This fact is especially hard to explain given how little changes in the cost of capital typically affect spending.[1] The excessive sensitivity of output to policy has prompted economists to look for endogenous mechanisms through which interest rate changes are greatly amplified. In this vein, recent theories have emphasized the role of informational frictions in tightening financing constraints following monetary contractions.[2] There are two main views on this transmission mechanism. The *lending channel* presumes that monetary policy affects the supply of loans by banks. Draining deposits from banks will reduce lending if banks face financial constraints when attempting to smooth these outflows by issuing uninsured liabilities. When lending relationships provide banks with an information advantage about their borrowers, firms find the credit offered by other sources to be an imperfect substitute. A monetary contraction therefore has much larger effects on the investment of bank-dependent firms than what is implied by the actual change in interest rates. The *balance sheet channel*, on the other hand, presumes that monetary policy affects loan demand through its effect on firms' net worth. Higher interest rates increase debt service, erode firm cash flow, and depress collateral values, exacerbating conflicts of interest between lenders and high information/agency cost borrowers. This deterioration in firm creditworthiness increases the external finance premium and squeezes firm demand for credit.

A growing number of studies have tried to assess empirically whether financial constraints indeed play a role in the transmission of monetary policy. Assuming that asset size should be correlated with the types of informational frictions that constrain access to credit, most of those studies compare how firms and banks in different size categories change their investment and lending behavior following policy changes.[3] A significant caveat to this literature is that this identification scheme cannot distinguish between the role of financial constraints in firms that would correspond to the balance sheet channel and those in banks that would correspond to the lending channel. Since small firms are typically bank-dependent, any observation that small firms are hurt the

[1] See Caballero (1997) for a survey of the literature on the sensitivity of investment to the cost of capital.

[2] See Hubbard (1994) or Bernanke and Gertler (1995) for a review of this literature.

[3] Bernanke, Gertler, and Gilchrist (1996) show that small and large firms have significantly different investment, growth, and inventory responses following monetary contractions. Similar findings are reported by Kashyap, Lamont, and Stein (1994), Oliner and Rudebush (1996), and Gilchrist and Himmelberg (1998). Using data from banks, Kashyap and Stein (1995, 2000) show that the lending of large commercial banks is significantly less sensitive to monetary policy than that of small banks.

hardest by a monetary contraction cannot distinguish between this being driven by a deterioration in firm creditworthiness or by a decline in the supply of credit by banks. Identifying the impact of monetary policy purely along the lines of the size of firms and banks is further compromised by the well-documented evidence that large (small) banks tend to concentrate their lending with large (small) firms. This association makes it difficult to disentangle a differential response of loan demand across firm size from a differential response of loan supply across bank size following policy shocks.

The ideal strategy for identifying the lending channel is to look at cross-sectional variations in banks' ability to smooth policy-induced deposit outflows holding constant the characteristics of those banks' loan portfolios. Recent studies suggest that small banks that are affiliated with large multi-bank holding companies (BHCs) are effectively 'larger' than their size would indicate with respect to the ease they smooth Fed-induced deposit outflows (see Ashcraft (2001) and Campello (2002)). Consistent with Kashyap and Stein's (2000) evidence on the behavior of large banks, those studies show that lending by small subsidiaries of large BHCs is less sensitive to monetary contractions than other similar small independent banks. This should happen because, differently from independent banks, members of large BHCs can resort to funds available from conglomerate's internal capital markets to finance their loans during a contraction.[4] Data from financial conglomerates has provided an identifying mechanism supporting the lending channel.

On the flip side, the ideal strategy for identifying the balance sheet channel is to examine cross-sectional differences in firms' financial constraints holding constant the characteristics influencing policy-sensitivity of the banks from which those firms borrow. This paper builds on the evidence that distributional policies promoted by internal capital markets in large BHCs eliminate differences in financial constraints across conglomerate members to conduct a novel test of the balance sheet channel. In particular, we argue below that the operation of internal capital markets implies that these banks are either (a) unconstrained or (b) similarly constrained (conditional on the traditional measures of financial constraints in banks) so that any differential response of lending to monetary policy across subsidiaries is driven by loan demand and not loan supply. Having eliminated loan supply shocks, we then look for evidence that some of these loan demand shocks are driven by the creditworthiness of firms to which banks are lending. We accomplish this by comparing monetary policy responses of similar size banks that are affiliated with the same BHC but that face different

[4]The most straightforward mechanism through which internal capital markets work is that the holding company could issue uninsured debt on cheaper terms than the subsidiary bank and then downstream funds to the bank. This could be done either via deposits or by purchasing loans from the bank; in either case the transaction would offset the impact of insured deposit outflows. See Mayne (1980) and Ashcraft (2001) for evidence on BHC fund channeling.

pools of borrowers. The borrowing clienteles are separated by looking at the lending of (same-BHC) small affiliates that reside in different geographical regions. Because these subsidiary banks typically concentrate their lending with small local businesses whose fortunes are tied to their local economies, we can exploit cross-sectional differences in local economic indicators at the time of changes of monetary policy to study whether borrowers' balance sheet strength influence the volume of bank lending.

In implementing this strategy in bank microdata, we first check whether there is evidence consistent with significant variations in borrowers' balance sheet strength for banks in a sample of small subsidiaries of multi-state bank holding companies. We do this by looking at the correlation between the business conditions in the localities where those subsidiary banks operate and the proportion of non-perfoming loans they report. Using Hodrick-Prescott-filtered series on local income gap for every US state, we find that differences across local economic conditions yield significant differences in the fraction of non-performing loans across subsidiaries of the same BHC. We then design a test of monetary policy transmission by relating the sensitivity of bank lending to local economic conditions and the stance of monetary policy over a 21-year period. We find that the negative response of loan growth to a monetary contraction is much stronger for subsidiaries operating during state-recessions than for subsidiaries of the same holding company that operate in state-booms. Our results hold for a number of different proxies for the stance of monetary policy, and our conclusions are robust to changes in the specification of our empirical models.

We design our tests so that usual concerns about the endogeneity of lending/borrowing decisions and financial constraints are minimized. This contrasts with other similar empirical studies, which have to rely on auxiliary tests to help address those concerns. However, one potential source of concern for our tests is sample selection. We collect data from banks belonging to certain types of financial conglomerates to identify the balance sheet channel of monetary policy. To the extent that financial institutions choose to organize their business in particular ways (e.g., operate in various geographical regions at the same time), one can argue that our data does not come from a random sample of banks and that our inferences could be biased. For instance, a selection bias story can be argued along the following lines. Expansionary monetary policies might prompt BHCs to enter new, fast growing markets (states). If a given BHC based in (and restricted to) state A sees an opportunity to enter the fast growing loans market of state B when access to reserves is easy, it may change its status from a single-state BHC to a multi-state BHC and thus enter our sample, possibly contaminating our findings. We address this and other scenarios in which sampling could be a source of concern for our empirical strategy in a number of different ways. Our principal findings remain unchanged.

A cautious interpretation of our study suggests that there are significant asymmetries in the impact of monetary policy on intermediated financing over the business cycle, with policy being more effective when the economy is in a recession than in a boom (see also Gertler and Gilchrist (1994)). As this asymmetry appears to be driven by the creditworthiness of borrowers, we interpret these findings as consistent with an active and independent balance sheet channel in the transmission mechanism of monetary policy. Such an interpretation suggests that when engaging in monetary policy the central bank should consider the amplification effects of changes in basic interest rates on the real economy which are generated by firm-level financial constraints. Our findings also add to the growing literature on the role internal capital markets play in the allocation of funds within conglomerate firms, particularly in financial conglomerates. This in turn points at need to understand in more detail the influence of conglomeration (and merger waves) on the impact of monetary policy on bank lending.

The rest of the paper is organized as follows. In Section 2, we outline a simple model describing the relevant theoretical questions addressed in our empirical analysis. Section 3 provides a description of the data and our sampling criteria. Our results are presented in Section 4. A number of robustness checks for our main findings are conducted in Section 5. Section 6 concludes the paper.

2 Theory

The balance sheet channel is typically modelled under the presence of agency problems between borrowers and lenders. These models imply that investment is limited by the value of collateral, and that policy-induced deterioration in collateral should lead to lower investment (see Bernanke, Gertler, and Gilchrist (1996)). Empirical researchers have loosely interpreted those models as to predict that the policy response of investment of a collateral-constrained firm should be larger than that of an unconstrained firm. Unfortunately, those theoretical models do not imply such argument, and it is easy to construct counterexamples where the opposite result obtains.[5] In this section, we advance a model that necessarily implies that differences in firm creditworthiness drive differential responses in investment demand to monetary policy.

[5]The effect of monetary policy on the investment of an unconstrained firm depends on the slope of the investment demand curve while the effect on a constrained firm depends on how much monetary policy affects the value of collateral. It is not clear from the extant models which of these effects should dominate.

2.1 Framework

The demand for investment and loans are intrinsically linked in our analysis. A firm can borrow w at time 0, investing it fully in a project that has time 2 return R with probability μ, and zero otherwise. Assume that the good state return R is increasing in the amount invested w while decreasing in the probability of the good state μ, that the cross-partial of R with respect to μ and w is non-negative, and that the expected return μR is concave in each of these arguments.[6]

In order to borrow w at interest rate r_b, the firm must put up collateral c in the form of risk-free securities that pay interest r_f at time 2.[7] So long as the value of the collateral is less than the size of the loan (i.e., $c < w$), the firm will default in the bad state. At time 0, the firm consists of these assets and an investment opportunity. It faces a decision of whether to borrow and produce, or to shut down and liquidate its collateral. The value of the owner's claim on the firm is,[8]

$$V = \mu[R + cr_f - wr_b] - cr_f. \tag{1}$$

2.2 Asset Risk

The firm privately chooses the probability of survival (asset risk) μ at time 1 after securing funding at time 0. This choice is non-verifiable and non-contractible, and combined with limited liability is the source of frictions in the model. The firm optimally chooses μ according to:

$$R + \mu\frac{\delta R}{\delta \mu} + (cr_f - wr_b) = 0. \tag{2}$$

A risk-neutral lender with opportunity cost equal to the risk-free rate of return r_f will price a bank loan of size w so that it is expected to return the risk-free rate. While the lender is unable to write a contract conditional on μ, it is able to anticipate the firm's time 1 equilibrium choice of μ according to Eq. (2). The time 0 price of debt can thus be written as,

$$r_b = \frac{wr_f - (1-\mu)c}{\mu w}. \tag{3}$$

Inserting this debt pricing equation into the firm's first-order conditions for μ describes the equilibrium choice of asset risk,

$$R + \mu\frac{\delta R}{\delta \mu} + r_f\frac{c - w}{\mu} = 0. \tag{4}$$

[6]The latter assumption is made so that first-order conditions with respect to each of w and μ characterize the optimal risk choice. The cross-partial rectriction is a sufficient condition for some of our results, but can be weakened.

[7]In this simple model, the value of collateral is essentially indistinguishable from the net worth of the firm.

[8]Since all cash flows occur at time 2, we ignore any discounting back to time 1 or time 0.

The first two terms of Eq. (4) correspond to those in the first-order conditions that maximize the expected value of assets. The last term, which is negative as $c < w$, corresponds to the risk-shifting incentives due to private risk choice. We define $M = r_f \frac{c-w}{\mu}$ as the marginal effect of asset risk created by leverage on the value of equity. M is a summary measure of the severity of the underlying moral hazard problems. Debt contracting under limited liability gives the following lemma.

Lemma 1

As long as the loan contract is only partially secured ($c < w$), the firm will choose a probability of survival μ that is less than the value of μ^* that maximizes the expected value of assets.

All mathematical proofs are provided in Appendix A. Before moving on to characterizing the optimal scale of investment at time 0, we highlight a few key properties of the optimal risk choice.

Lemma 2

The firm's optimal choice of asset risk μ has the following properties: (a) $\mu_{r_f} < 0$; (b) $\mu_w < 0$; (c) $\mu_c > 0$; (d) $\mu_{r_f c} > 0$; (e) $\mu_{wc} > 0$; (f) $\mu_{r_f w} < 0$; and (g) $\mu_{r_f wc} > 0$.

The first three results of the lemma are fairly intuitive. Results (a) and (b) indicate that a higher interest rate r_f or a larger loan size w induces the firm to increase asset risk by decreasing μ, while (c) suggests that net worth c induces the firm to reduce asset risk. Results (d) and (e) show that collateral also mitigates firm incentives to increase risk in response to an increase in the risk-free rate or loan size. Result (f) indicates that loan size and the risk-free rate have complementary effects on risk-taking, as a higher risk-free rate implies a greater reduction in the probability of survival μ for a given change in loan size. Finally, result (g) indicates that the presence of collateral also mitigates the complementarities between interest rates and loan size.

2.3 Investment

Returning to the expression for the net value of equity, Eq. (1), we take first-order conditions at time 0 with respect to loan size w, using the envelope theorem to ignore the effect of w on V through μ, and then use Eq. (3) to characterize the firm's equilibrium investment decision,

$$\frac{\delta R}{\delta w} = \frac{r_f}{\mu} + \frac{\delta \mu}{\delta w} M = MC. \tag{5}$$

The left-hand side of this equation is simply the marginal return in the good state of the last dollar borrowed, while the right-hand side is the marginal cost of the last dollar in that same state. This marginal cost is broken into two parts. The first term corresponds to the increase in cost holding the interest rate constant, while the second term captures the increase in cost driven by a change in the interest rate. Note that increasing marginal costs of finance are entirely due to moral hazard, and that they disappear when the choice of asset risk no longer depends on the amount borrowed (i.e., $\mu_w = 0$) or when $M = 0$. Since the investment scale is determined by the marginal cost, it is not surprising that agency problems lead to underinvestment.

Lemma 3

As long as the loan contract is only partially secured ($c < w$), the firm will invest less than it would in the absence of private information about asset risk and limited liability.

The optimal investment scale w is depicted in Figure 1. The marginal cost is constant at r_f until loan size equals the value of collateral c, where it jumps to $\frac{r_f}{\mu}$. In the absence of agency problems, the marginal cost is constant thereafter, and optimal investment scale occurs at w^*. In the presence of agency problems, on the other hand, incentives for asset substitution worsen as loan size increases, creating the increasing marginal cost schedule depicted in the figure. These higher marginal costs of funds lead to underinvestment by the firm, which borrows only w ($< w^*$).

2.4 The Transmission Mechanism: Defining the Balance Sheet Channel

We now consider the effect of monetary policy on investment. This can be done by differentiating Eq. (5) with respect to the risk-free rate,

$$\frac{\delta MC}{\delta r_f} = \frac{1}{\mu} - \frac{r_f}{\mu^2}\mu_{r_f} + \frac{\delta^2 \mu}{\delta w \delta r_f} M + \frac{\delta \mu}{\delta w} M_{r_f} > 0. \tag{6}$$

The effect of monetary policy on the marginal cost of capital works through two channels. First, a higher risk-free rate requires the lender to raise the loan interest rate. Since this is repaid only when the firm survives the lender must raise the loan rate more for firms that are more likely to default. Second, a higher risk-free rate worsens the underlying agency problems, affecting firm incentives to increase asset risk and loan size. Both of these effects — captured by the final three terms of Eq. (6) — work in the same direction and amplify the impact of policy changes on investment.

The effect of monetary policy on investment is illustrated in Figure 2. In the absence of agency problems, the marginal cost of funds is constant at $\frac{r_f}{\mu}$. An increase in the risk-free rate shifts this marginal cost schedule up, reducing investment by Δw^*. In the presence of limited liability and private information, however, an increase in the risk-free rate also worsens underlying moral hazard problems and steepens the slope of the marginal cost curve, further increasing the cost of funds, and reducing investment by Δw ($> \Delta w^*$).

We summarize the main points of our analysis thus far in the form of a proposition.

Proposition 1

The following mechanisms describe the impact of monetary policy changes on intermediated investment of financially-constrained borrowers:

(i) The effect of monetary policy on investment is amplified when policy changes increase the firm's probability of default (even in the absence of agency problems);

(ii) The effect of monetary policy on investment is amplified by the severity of underlying agency problems, as agency induces firms to assume excessive risk; and

(iii) Monetary policy may worsen agency problems, even when ignoring its effect on the value of collateral, further amplifying its effect on investment.

Let us now consider the effect of collateral on investment through the marginal cost of finance. This can be gauged from the following expression:

$$\frac{\delta MC}{\delta c} = -\frac{r_f}{\mu^2}\mu_c + \frac{\delta^2 \mu}{\delta w \delta c} M + \frac{\delta \mu}{\delta w} M_c < 0. \tag{7}$$

The first term indicates that in the presence of incentives for asset substitution the use of collateral mitigates incentives, reducing the firm's marginal cost of funds and thus underinvestment.[9] The second two terms show that collateral also mitigates incentives for the firm to increase asset risk as loan size increases, this further reduces borrower's marginal cost of external financing. This effect of collateral on investment captures what is traditionally thought of as the *balance sheet channel* of monetary policy. A policy-induced deterioration in the value of firm collateral worsens incentives for risk-taking (along with the complementarities between investment size and risk), which amplifies the increase in the cost of debt, further reducing investment. In Figure 2, this corresponds to making the slope of the marginal cost curve even steeper and pulling it back towards the origin.

We have demonstrated that the presence of agency problems necessarily amplifies the effect of monetary policy on investment and that the use of collateral mitigates these problems. It is now straightforward to show that the effect of monetary policy on investment is amplified by any effect that policy has on the value of firm collateral. We conclude our theoretical analysis by characterizing the interaction between collateral value and the response of investment to policy.

Proposition 2

Collateral mitigates the effect of monetary policy on the marginal cost of funds, reducing the impact of policy changes on investment (i.e., $\frac{\delta^2 MC}{\delta r_f \delta c} < 0$*).*

[9] In absence of agency problems, the marginal cost curve is constant, and thus collateral has no effect on investment.

The intuition here is simply that the effect of monetary policy on investment is amplified by the probability of default, and that as the value of collateral falls firms choose riskier projects. This result also implies that there is a built-in accelerator effect in policy. In a sequence of contractions, the effect of monetary policy on investment becomes stronger with each subsequent increase in the risk-free rate. As each contraction increases default risk through the effect policy has directly on product demand and through the indirect effects policy has on risk-taking, the cost of debt and thus investment becomes more sensitive to further changes in the risk-free rate.

2.5 Taking the Theory to Data: What is Feasible?

With the above framework it is possible to formally define the *balance sheet channel* as the response of investment to monetary policy that is driven by policy-induced changes in firm creditworthiness. We recognize two mechanisms through which this can occur: monetary policy has a direct effect on default risk through its actual and expected effect on output, and policy has an indirect effect on risk choice through its impact on the value of collateral. Understanding the interactions among these mechanisms, we believe, provides a step forward in understanding the endogenous propagation of monetary policy changes throughout the economy.

Of course, it is quite difficult to disentangle empirically the marginal importance of agency problems in this channel of monetary policy. In firm microdata, the challenge is to isolate variation across firms in the severity of agency problems that is uncorrelated with the underlying riskiness of the projects in which they invest. It should be clear that the measure used in the existing literature — namely, firm size — does not accomplish that task as small firms likely invest in riskier projects than large firms. At the same time, it is not clear that variation across firms in the severity of agency problems will help identify a balance sheet if there is a lending channel, as high informational cost firms typically borrow from banks.

So what is feasible? In what follows, we first turn to bank microdata to devise a strategy that shuts down the lending channel, and then difference the response of investment to monetary policy across the components of default risk that are likely affected by policy. We feel that differences in local business conditions isolate quite well these components as they capture the greater risk of default due to: a) lower product demand, and b) worsening of agency problems caused by deterioration in collateral values.[10] The details of our identification strategy are discussed in the

[10] We recognize that local business conditions also reduce the marginal product of investment. We, however, do not compare the level of investment across business conditions. Instead, we exploit cross-sectional differences in the response of investment to monetary policy across business conditions, so the assumption is that the marginal product of investment schedule does not flatten out as conditions deteriorate. In the context of the model above, while we

next section.

3 Sampling Methodology

In order to identify the response of a loan *demand* to monetary policy it is necessary to eliminate any differences in financial constraints across banks that would drive a differential policy-response of loan *supply*. Such an analysis requires one to look at banks that face similar financial constraints, but experience differential strength in their borrowers' balance sheets. Our study implements such a strategy to look for evidence on the balance sheet channel of monetary policy. In this section, we describe the identification problem and our approach in detail, we then discuss our data.

3.1 Identification

We model the differential response of bank lending to monetary policy across banks by explicitly separating the demand and supply-side effects of monetary policy. Let r_t denote the stance of monetary policy as of time t. Eq. (8) writes the response of loan growth to policy for an individual bank i that is part of BHC j at time t,

$$\frac{\delta \Delta ln(Loans)_{ijt}}{\delta r_t} = \alpha_0 + \alpha_1 D^{bs}_{ijt} + \alpha_2 D^{nbs}_{ijt} + \alpha_3 S^{bank}_{ijt} + \alpha_4 S^{BHC}_{ijt} + v_{ijt}. \quad (8)$$

Differences in the response of loan *demand* across banks are captured by D^{bs}_{ijt} and D^{nbs}_{ijt}, which correspond to balance sheet and non-balance sheet effects, respectively. The first of these demand effects can be understood in the spirit of our model, where the response of demand to monetary policy is mitigated by the strength of firm creditworthiness. The second refers to changes in loan demand that are not related to firm financial strength. Firms involved in the manufacture of durable goods, for example, have product demand that is more sensitive to monetary policy than other firms. One should thus expect relatively more policy-sensitive lending by banks that concentrate their loans with such firms. Differences in the response of loan *supply* across banks are driven by differences in the severity of financial constraints at the bank level, S^{bank}_{ijt}, or at the holding company level, S^{BHC}_{ijt}.[11] These latter controls capture lending channel effects, where financial constraints affect the ability of banks to replace outflows of insured deposits with funds from other sources.

recognize that business conditions can affect R_w, we assume they are exogenous to R_{ww}.

[11] Dependence on holding company-level financial strength is induced by regulation requiring that financial conglomerates must operate on consolidated basis. See Houston, James, and Marcus (1997) for a discussion.

Given the appropriate data on each of these regressors, estimating Eq. (8) via OLS would recover the correlation between firm balance sheet strength and the response of bank lending to monetary policy through the estimate of α_1. The problem with this strategy, though, is lack of data on relevant dimensions of each of the regressors. In particular, there are likely to be unobserved components of D^{nbs}_{ijt}, S^{bank}_{ijt}, and S^{BHC}_{ijt} that are correlated with the observed dimensions of firm balance sheet strength D^{bs}_{ijt}, in which case the OLS estimation will be compromised by omitted variables bias.

We attempt to minimize this problem using a number of devices. First, we restrict our sample to banks that are affiliated with large multi-bank holding companies. This follows from recent evidence on the bank lending channel. Kashyap and Stein (2000) show that large commercial banks are mostly insensitive to monetary policy shocks, as their ability to tap on non-reservable sources of funds at low cost allows them to shield their lending from Fed-induced contractions. Ashcraft (2001) and Campello (2002) further show that, just like large banks, subsidiaries of large BHCs are far less constrained than comparable independent banks during contractions. Based on these findings, that sample restriction alone should all but eliminate the importance of bank (supply-side) financial constraints in explaining the response of lending to monetary policy, allowing us to disregard S^{bank}_{ijt} and S^{BHC}_{ijt}.[12] We, however, weaken such an assumption and estimate Eq. (8) including a set of controls which, according to the lending channel literature, should exhaust the sources of variation in bank-level financial constraints: capitalization, size, and liquidity.

The second device we employ to mitigate omitted variables bias is to focus the analysis on the difference between a subsidiary's response to monetary policy and that of the other banks affiliated with the same holding company. Focusing on within-conglomerate comparisons is useful because it eliminates financial constraints at the BHC-level from the equation, purging a potential source of bias, and potentially eliminates any residual differences in financial constraints across subsidiaries.[13]

Define Ω^{x}_{ijt} as the difference between a subsidiary's x_{ijt} and its holding company mean in a

[12] Small banks that are part of large holding companies do not face the same agency problems that face small stand-alone banks. While limited liability and private information about loan quality are a source of agency problems for small stand-alone banks banks, one can argue under the Federal Reserve's Source of Strength policy that the BHC owners of small banks face full liability for their subsidiary's debts. This is an important check incentives for asset substitution by the subsidiary as large BHCs have massive amounts of resources relative to their small subsidiares. In our sample, the 90^{th} percentile of the subsidiary-to-BHC size ratio is only five percent. In another paper, we also find evidence that banks affiliated with large BHCs are more likely to recover from and recover more quickly from financial distress than similar stand-alone banks.

[13] While it is possible that these small subsidiary banks remain constrained in issuing large CDs and securing federal funds to the market, it is possible that the parent is able to resolve agency problems within the holding company. Stein (1997) develops a model where with access to private information about subsidiary risk-taking unavailable to the market, the parent is able to eliminate differences in financial constraints across subsidiaries so that $\alpha_3 = 0$, even though the holding company might remain constrained vis-a-vis the market.

given quarter. We can re-write Eq. (8) in differences from the holding company mean as follows,

$$\frac{\delta\Omega_{ijt}^{Loans}}{\delta r_t} = \alpha_1 \Omega_{ijt}^{D^{bs}} + \alpha_2 \Omega_{ijt}^{D^{nbs}} + \alpha_3 \Omega_{ijt}^{S^{bank}} + v_{ijt}. \tag{9}$$

Once we have minimized supply-driven differences in loan-policy responses, the next device we use is to isolate independent sources of cross-sectional variations in borrower balance sheet strength. Arguably, depressed economic activity within a state will lead to a deterioration in local borrowers' creditworthiness, as small, local businesses fortunes (cash flows, collateral values, etc.) are intrinsically tied to their local economies. Our identification scheme is complete if we can assume that these borrowers concentrate their lending with small banks.[14] We thus isolate differences in borrowers' strength across members of a given conglomerate ($\Omega_{ijt}^{D^{bs}}$) by looking at data from small subsidiaries of large multi-state conglomerates.

We note that our approach is only sound if we isolate from D_{ijt}^{bs} those unobserved components that are likely to be correlated with D_{ijt}^{nbs}. This is not an obvious task. The solution involves the observation that variations in D_{ijt}^{bs} can be broken out into both high-frequency and low-frequency components. The low frequency component is potentially correlated with D_{ijt}^{nbs}.[15] The high-frequency component of D_{ijt}^{bs}, on the other hand, is plausibly independent of non-balance sheet factors. In implementing our tests, we exploit high-frequency variations in borrowers' balance sheets that are induced by short-run changes local business conditions. In essence, we make the assumption that short-term deviations from long-run economic trends at the state level are uncorrelated with non-balance sheet drivers of the response of bank lending to monetary policy, D_{ijt}^{nbs}, and unobserved measures of bank-level financial constraints, S_{ijt}^{bank}.

3.2 Data

All of the microdata used in this paper come from banks. We collect quarterly accounting information on the population of insured commercial banks from the Federal Reserve's *Call Report of Income and Condition* over the 1976:I-1998:II period, using a version of the data cleaned by the Banking Studies Function of the Federal Reserve. After a initial screening, we retain only bank-

[14] Such an assumption is strongly supported by research on business lending practices of small and large banks (see, e.g., Nakamura (1994), Strahan and Weston (1998), and di Patti and Gobbi (2001)). Ashcraft (2001) highlights the differences in small loan concentration — often used as a proxy for borrower size — across bank size categories. As of 1996, for example, a typical small bank had 70 percent of its loan portfolio composed of small loans (face value of less than $250,000), compared to 30 percent for large banks (see also Peek and Rosengren (1997)).

[15] Recall, D_{ijt}^{nbs} drives differences in the response of loan demand to monetary policy that are not created by borrower financial constraints, but by underlying characteristics of the borrowers in a market (or state), such as the sensitivity of product demand to monetary policy. It seems reasonable to assume that such characteristics (e.g., industrial structure) evolves quite slowly over time and are essentially fixed over short time intervals.

quarters with positive values for total assets, loans, and deposits. Details about the construction of the panel data set and formation of consistent time series are provided in Appendix B.[16]

The single most important bank-level variable used in our analysis is loan growth. This variable is defined as the quarterly time series difference in the log of total loans. We use the bank merger file published online by the Federal Reserve Bank of Chicago to remove any quarter in which a bank makes an acquisition. This reduces measurement problems with the differenced data. In addition, we eliminate bank-quarters with loan growth exceeding five standard deviations from the mean. Since the regressions below include four lags of loan growth as explanatory variables, the sample is limited to banks having at least five consecutive quarters of data. The first five quarters of our data set are lost in order to construct lagged dependent variables and appropriate differences.

Our analysis focuses on the lending of small banks. This sample restriction is made in order to best match the market (state) in which the bank is chartered with local business conditions.[17] Consistent with previous studies, we define as "small banks" those banks in the bottom 95^{th} percentile of the assets size distribution of all observations in a given quarter.[18] The second restriction we impose on the data is to retain only small banks that are part of multi-bank holding companies which control at least one large bank (i.e., a bank in the top 5^{th} percentile of the asset distribution). There are 94,333 small bank-quarters associated with large BHCs in the 1977:II-1998:II period. Next, we require that small banks must be affiliated with holding companies that have subsidiaries residing in at least two different U.S. states during the same quarter. This later restriction leaves 38,599 bank-quarters in our data set. The time distribution of the number of observations in our sample of multi-state BHC subsidiaries is reported in Table 1. The table shows a steady increase in the number of observations in each quarter until the advent of problems in the banking industry in the late 1980s. During the last decade, consolidation within the industry (and within BHCs) has reduced the number of small banks affiliated with large BHCs.[19]

The first column of Table 2 reports the mean and standard deviation of the bank-level variables used in our tests. The statistics in the first column of the table are for the small banks that are included in the sample. The figures for basic balance sheet information such as size, loan growth,

[16]Program code is available from the authors upon request.

[17]Large banks' loan opportunities are likely to be poorly measured by the economic conditions of the states in which they are chartered.

[18]Results are qualitatively similar when we employ other size cutoff criteria also used in previous empirical work, such as the 90^{th} and 75^{th} asset size percentiles.

[19]Without weighting these trends, statistics constructed on this sample would place an unusual amount of weight on the first decade of data. As the analysis below is done quarter by quarter, this will not be a concern. The potential impact of deregulation on our sample (and thus on our results) is explicitly considered below.

leverage, etc., are similar to those reported in other studies on small banks. Banks in our final sample display a quarterly loan growth average of 1.57 percent with a standard deviation of 7.6 percent. Note that the standard deviation of long-run loan growth and non-performing loans are similar in magnitude to the long run means, implying that there are large differences across banks in long-run average loan growth and non-performing loans.

As we discuss below, we must be concerned with the fact that our data selection criteria may create sample biases that affect our inferences. To check whether the observations in our sample are "unique" in some obvious way, we also compute descriptive statistics for the variables of interest using all of the population of small banks that are left out of our sample. These are displayed in the second column of Table 2. Comparisons based on those statistics suggest that one would have a difficult time arguing that small subsidiaries of multi-state BHCs are very different from other banks in the same size category.

Finally, our analysis also necessitates data on the stance of monetary policy and on the business environment in which the small affiliate banks in our sample operate. The measures of monetary policy we use are fairly standard and are described in detail in Appendix C. Most of these policy measures are constructed with series available online from FRED at the Federal Reserve Bank of St. Louis. In order to measure local business conditions we use nominal state income series available online from the Bureau of Economic Analysis. Deviations from the long-run economic growth trend in each state are used to characterize state-recessions and state-booms. Specifically, a state 'income gap' ($YGap$) is constructed by applying a Hodrick-Prescott filter (bandwidth of 1600) to the time series difference of the log of total state income for each state and the District of Columbia. A positive $YGap$ indicates a state boom.

4 Empirical Results

4.1 Local Business Conditions and Bad Loans

In order to substantiate our testing strategy we need to find evidence that depressed economic activity actually depresses borrowers' balance sheets. To our knowledge, there are no publicly available data on small firms' borrowings that serve our purposes. On the other hand, we have data on the loan portfolio of their banks. In establishing a link between the local economic environment and firm balance sheets, we argue that an unexpected deterioration in firms' conditions should show up in the quality their banks' loan portfolio. We examine this working hypothesis in turn.

For each bank i affiliated with the BHC j at time t, let $\Omega_{ijt}^{BadLoans}$ denote the difference between a subsidiary's bad loans (i.e., the ratio of non-performing to total loans) and the average bad loans of all other small banks in the same BHC. Similarly, define Ω_{ijt}^{YGap} as the difference between a subsidiary's state income gap and the average income gap of all other small banks in its BHC,

$$\Omega_{ijt}^{BadLoans} = BadLoans_{ijt} - \overline{BadLoans_{jt}}, \tag{10}$$

$$\Omega_{ijt}^{YGap} = \Delta ln(YGap_{ijt}) - \overline{\Delta ln(YGap_{jt})}. \tag{11}$$

The issue of interest is whether subsidiaries operating in state-quarters with relatively poorer economic conditions report a greater fraction of loans gone bad. We use the following empirical model to address this question:

$$\Omega_{ijt}^{BadLoans} = \eta + \sum_{k=1}^{4} \lambda_k \ Local\ Shock_{ijt-k} + \Omega_{ijt-k}^{\mathbf{X}} + \sum_t \alpha_t 1_t + \varepsilon_{ijt}. \tag{12}$$

The set of controls included in $\mathbf{X}$ is composed of lagged log assets, the lagged bank equity ratio, and the lag of bank liquid assets. The α coefficients absorb time-fixed effects. The four lags of the local economic shocks are meant to capture the relative strength of the balance sheets of the subsidiary bank's borrowers. For robustness, we measure these shocks in two ways: a) simply as the log change in the state income gap ($YGap$), and b) as the correspondent relative-to-BHC measure (Ω_{ijt}^{YGap}). We are, of course, interested in the relationship between a small subsidiary's ratio of bad loans and the financial status of the businesses in its market, captured by $\sum \lambda_k$.

We report the estimates returned for $\sum \lambda_k$ from Eq. (12) in the first column of Table 3. Panel A uses the state income gap $\Delta ln(YGap_{ijt})$ as the local shock proxy, while Panel B uses Ω_{ijt}^{YGap}. The most conservative estimate in the table (-0.025) implies that an increase in the state income gap by one standard deviation (about 2.4 percentage points) reduces the fraction of bad loans in a small bank's loan portfolio by about 6 basis points. Notice that this estimate represents the impact of a local slowdown on bad loans in the current quarter alone, and that the cumulative deterioration in firm credit quality could be several times as large over a longer time horizon.

One potential limitation with the specification above is that it exploits both permanent and transitory differences in the fraction of bad loans across subsidiaries. In principle, we are interested in bad loans created by what are temporary changes in local economic conditions, so it makes sense to eliminate long-run individual bank effects. This can be accomplished by separating out bank-level long-run differences relative to the BHC, defining $\Omega_{ijt}^{\widetilde{BadLoans}}$ as follows:

$$\Omega_{ijt}^{\widetilde{BadLoans}} = \Omega_{ijt}^{BadLoans} - \overline{\Omega_{ij}^{BadLoans}}. \tag{13}$$

We re-examine the question of relative loan performance, now only exploiting transitory differences in bad loans across subsidiaries, by estimating the following equation:

$$\widetilde{\Omega_{ijt}^{BadLoans}} = \eta + \sum_{k=1}^{4} \lambda_k \ Local\ Shock_{ijt-k} + \beta \Omega_{ijt}^{\mathbf{X}} + \sum_{t} \alpha_t 1_t + \varepsilon_{ijt}. \tag{14}$$

The results from this last estimation are reported in the second column of Table 3. There continues to exist strong evidence that differences in the state income gap are correlated with differences in non-performing loans across bank subsidiaries of multi-sate BHCs. We interpret these results as supporting evidence for using the state income gap as a proxy for borrower creditworthiness.

4.2 Local Business Conditions and Asymmetric Monetary Policy Effects

We have established that cross-sectional differences in economic conditions among the various markets in which a conglomerate operates correlate with differences in the loan quality (indicative of borrowers' financial strength) among the various subsidiaries of that conglomerate. We now turn to the main question of the paper: Whether there's a balance sheet channel of monetary policy.

To investigate this transmission mechanism we use a two-step approach which resembles that of Kashyap and Stein (2000). The idea is to relate the sensitivity of bank lending to local economic conditions and the stance of monetary policy by combining cross-sectional and times series regressions. The approach sacrifices estimation efficiency, but reduces the likelihood of Type I inference errors; that is, it reduces the odds of concluding that borrowers' finances matter when they really don't.[20]

Define Ω_{ijt}^{Loans} as the difference between a small subsidiary lending and the average loan growth of all other small banks in the conglomerate. The first step of our procedure consists of running the following cross-sectional regression for every quarter t in the sample:

$$\Omega_{ij}^{Loans} = \eta + \sum_{k=1}^{4} \pi_k \Omega_{ijt-k}^{Loans} + \sum_{k=1}^{4} \gamma_k \ Local\ Shock_{ijt-k} + \beta \Omega_{ij-1}^{\mathbf{X}} + \varepsilon_{ij}. \tag{15}$$

To explicitly account for the idiosyncractic effects discussed above, we also estimate the following 'double-differenced' equation:

$$\widetilde{\Omega_{ij}^{Loans}} = \eta + \sum_{k=1}^{4} \pi_k \widetilde{\Omega_{ijt-k}^{Loans}} + \sum_{k=1}^{4} \gamma_k \ Local\ \widetilde{Shock}_{ijt-k} + \beta \widetilde{\Omega_{ij-1}^{\mathbf{X}}} + \varepsilon_{ij}, \tag{16}$$

where $\widetilde{\Omega_{ijt}^{Loans}} = \Omega_{ijt}^{Loans} - \overline{\Omega_{ij}^{Loans}}$, and similarly for the remaining variables.

[20] An alternative one-step specification — with Eq. (17) below nested in Eq. (15) — would impose a more constrained parametrization and have more power to reject the null hypothesis of borrowers' finances irrelevance. However, tests of coefficient stability indicate that the data strongly rejects those parameter restrictions.

From each sequence of cross-sectional regressions, we collect the coefficients returned for $\sum \gamma_k$ and 'stack' them into the vector Ψ_t, which is then used as the dependent variable in the following (second stage) time series regression:[21]

$$\Psi_t = \alpha + \sum_{k=1}^{8} \phi_k MP_{t-k} + \sum_{k=1}^{8} \mu_k \Delta ln(GDP)_{t-k} + \sum_{k=1}^{3} \sigma_k Q_k + \rho Trend + u_t. \quad (17)$$

We are interested in the impact of monetary policy, MP, on the sensitivity of loan growth to borrower balance sheet strength. The economic and the statistical significance of the impact of monetary policy in Eq. (17) can be gauged from the sum of the coefficients for the eight lags of the policy measure ($\sum \phi_k$) and from the p-value of this sum. Since there is little consensus on the most appropriate measure of the stance of monetary policy we use five alternative proxies in all estimations we perform: a) the Fed funds rate (Fed Funds); b) the spread between the rates paid on six-month prime rated commercial paper and 180-day Treasury bills (CP-Bill); c) the spread between the Fed funds rate and the rate paid on 10-year Treasury bills (Funds-Bill); d) the log change in non-borrowed reserves (NonBorrowed); and e) Strongin's (1995) measure of unanticipated shocks to reserves (Strongin). All monetary policy measures are transformed so that increases in their levels represent Fed tightenings. Because policy changes and other macroeconomic movements often overlap, we also include eight lags of the log change in real GDP in the specification in order to check whether policy retains significant predictive power after conditioning on aggregate demand. The variable Q corresponds to quarter dummies, and $Trend$ represents a time trend.

Figure 3 plots the empirical distribution of the coefficient of interest from the first stage regressions, $\sum \gamma_k$. We perform the first stage estimations of our two-step procedure in four different ways (see below), which yields a total of 364 coefficient realizations. As expected, those regressions return positive estimates in most runs. The mean (median) $\sum \gamma_k$ equals 0.078 (0.027) and is statistically different from zero at the 0.1 (0.1) percent level. A positive coefficient indicates that there is more demand for credit in states where business conditions are more favorable. Although they agree with our intuition, these results alone don't say much about the dynamics of the transmission of monetary policy.

The main results of the paper are shown in Table 4. The table reports the sum of the coefficients for the eight lags of the monetary policy measure ($\sum \phi_k$) from Eq. (17), along with the p-values

[21] To see how this procedure accounts for the error contained in the first-step, assume that the true Ψ_t^* equals what is estimated from the first-step run (Ψ_t) plus some residual (ν_t): $\Psi_t^* = \Psi_t + \nu_t$. One would like to estimate Eq. (17) as $\Psi_t^* = \alpha + \mathbf{X}\theta + \omega_t$, where the error term would only reflect the errors associated with model misspecification. However, the empirical version of Eq. (17) uses Ψ_t (rather than Ψ_t^*) on the right hand-side. Consequently, so long as $E[\mathbf{X}'\nu] = 0$, α will absorb the mean of ν_t, while u_t will be a mixture of ν_t and ω_t. Thus, the measurement errors of the first-step will increase the total error variance in the second-step, but will not bias the coefficient estimates in θ.

for the sum. Heteroskedasticity- and autocorrelation-consistent errors are computed with Newey-West lag window of size eight in all regressions. The table summarizes the results of 20 two-step estimations (four different first stage regressions × five monetary policy measures). The results in Panel A use the state income gap $\Delta ln(YGap_{ijt})$ as the proxy for local borrowers' financial status, while those in Panel B use Ω_{ijt}^{YGap} (the difference between the income gap facing a subsidiary and the average gap of all other subsidiaries of the same BHC) as the relevant proxy. The first row of each panel reports results from regressions that use Ω_{ijt}^{Loans} (the relative-to-BHC subsidiary loan growth) as the dependent variable (see Eq.(15)), while those in the second row use $\widetilde{\Omega_{ijt}^{Loans}}$ (the double-differenced Ω_{ijt}^{Loans}) as the dependent variable (Eq. (16)).

All of the coefficients reported in Table 4 suggest that borrowers' financial status influence the response of bank lending to monetary policy along the lines of the balance sheet channel. Importantly, most measures of monetary policy return statistically significant estimates. This is remarkable given well-documented differences in the time series properties of policy measures based on the interest rates and those based on monetary aggregates. Of those estimates, ten (five) are significant at the 9.6 (3.9) percent level or better. The coefficients for the most conventional measure of policy, the federal funds rate, are all significant at better than the 6.5 percent level.

In order to interpret the economic significance of those estimates, it is necessary to design a baseline policy experiment. Consider the scenario in which the central bank increases the funds rate by 25 basis points and keeps it there for eight quarters, implying a 200 basis point change over the entire horizon. Using the most conservative of our fed funds rate estimates (0.031), a one standard deviation deterioration in the state income gap (0.025) would amplify the impact of the contraction on bank loan growth by some 15 basis points in the current quarter alone. To see what this result would imply in dollar terms, consider two subsidiaries of the same BHC, both with a loan portfolio equal to \$100 million (about the average figure for banks in our sample as of 1998:II). Suppose one of the subsidiaries operates in a state where the income gap is one standard deviation above its average and the other operates in a state where the income gap is one standard deviation below average. Then a 25 basis point increase in the fed funds rate sustained over eight quarters would lead the bank facing a local slump to cut back on lending by \$300,000 more in the current quarter than the bank facing a local boom.

Table 5 illustrates the complete 'impulse-response' of the amplification mechanism described in Table 4 using the federal funds rate as the measure of monetary policy. The rows of Table 5 are similar to those in the previous table, while the columns correspond to the point estimate and *p*-

value for sum of coefficients of different lags of the funds rate. The time pattern describes an initial effect of 1.5 to 2 percent on the current quarter that increases to 3 to 4 percent after eight quarters. These estimates indicate that the bulk of the amplification effect implied by the balance sheet channel takes place immediately after a policy change. They also show that the effects of monetary policy on bank lending that are induced by borrowers' weakening is very persistent through time. The timing and duration of balance sheet effects we report are comparable to those in Gertler and Gilchrist (1994). These patterns indicate that the presence of borrowers' financial constraints help explain the excessive sensitivity of bank credit and output to short-term interest rates. They also suggest the existence of strong asymmetries in the transmission mechanism of monetary policy over the business cycle. These asymmetries need to be acknowledged both in forecasting future economic performance and in the design of policy.

The analysis of this section established that there are important differences in the response of bank loan growth to monetary policy over the state business cycle, which we interpret as consistent with a balance sheet channel of monetary policy. Before we conclude, however, we discuss some potential weaknesses of the evidence above.

5 Robustness

Although our approach resembles Kashyap and Stein's (2000) two-step procedure, our analysis is far less subject to the types of simultaneity biases discussed in their paper. Specifically, while our second-stage times series regressions are similar to those of Kashyap and Stein, their paper's first-stage regressions involve estimating the sensitivity of a bank's choice variable (lending) to another *endogenous* variable (liquidity). Our first-stage regressions, in contrast, involves estimating the sensitivity of lending to local economic conditions, which are *exogenous* to the bank's decision set. This relieves us from having to consider whether our results could be explained away under various scenarios in which banks may choose to behave in a particular way (say, they may hold more liquid assets) when they know their borrowers to be especially sensitive to monetary policy or business cycles. Our approach, on the other hand, is subject to other types of criticisms.

5.1 Sample Selection: Heckman Correction

One potential source of concern for our tests is sample selection. In particular, we sample from the population of insured commercial banks only those banks belonging to certain types of financial conglomerates. To the extent that those financial institutions *choose* to organize their business as multi-bank firms and decide whether or not to operate in various geographical regions at a given point in time, one can argue that our data do not come from a random sample of banks. If this sample of banks was constant over the entire sample period, this would not be a problem as inferences could simply be done conditional on the sample. The potential problem is that the sample changes in non-random ways over time as bank holding companies acquire other institutions and consolidate their subsidiaries into larger banks.

A *selection bias* story can be argued along the following lines. Expansionary monetary policies might prompt BHCs to expand into new markets (states). If a given BHC based (and restricted to) Massachusetts sees an opportunity to enter the fast growing loans market of Rhode Island when access to reserves is easy it may change its status from a single-state BHC to a multi-state BHC, thus entering our sample. If there are unobserved financial constraints across banks, changing the number of banks in the holding company via mergers and acquisitions will change the average sensitivity of lending to economic conditions unless the holding adds a bank with a sensitivity exactly at the other subsidiaries' mean. Recall, that the lending of more financially constrained banks should be more sensitive to economic conditions, and that the balance sheet channel implies that a monetary expansion should reduce the sensitivity of lending to borrowers' financial constraints. Thus the main threat to identification from sample selection is that during a monetary expansion BHCs are acquiring small banks that are financially unconstrained (in unobserved dimensions) relative to banks in the holding company.[22] Of course, such a story would require a bank's acquisition strategy to quickly reverse itself as the stance of monetary policy changes, which seems unlikely. However, a more general argument linking geographic diversification to local economic conditions and the monetary policy cycle could pose a challenge to our main conclusions.

Our first line of defense against this argument comes from the fact that the secular movements towards deregulation of conglomerate activities and mergers are already captured in our second stage regression through the included trend. As it turns out, this regressor never shows any statistical significance. Our second (more formal) strategy in addressing that argument consists of a couple of Heckman-type corrections for sample selection. We explain the details in turn.

Let y_i correspond to the sensitivity of loan growth to interest rates. We are interested in how this sensitivity changes in response to the state income gap, which is in the subset of regressors x_i

$$y_i = \beta x_i + \varepsilon_i. \tag{18}$$

[22]Similarly, it would be a problem if BHCs were acquiring small banks that are financially constrained relative to the other subsidiaries during a monetary contraction.

Our problem in estimating Eq. (18) is that we do not have a random sample of banks and it is possible that bank holding companies tend to acquire banks operating under specific circumstances (e.g., during local economic booms).

Define z_i^* an indicator function for being part of the sample, and w_i the vector of variables which affect this probability

$$z_i^* = 1(\gamma w_i + u_i > 0). \tag{19}$$

It is standard to assume u_i and ε_i as bivariate normal random variables with zero mean, variances σ_u and σ_ε, respectively, and correlation ρ. The conditional expectation of y_i for the observations in our sample can be written as

$$E[y_i|z_i^* > 0] = \beta x_i + E[\varepsilon_i|z_i^* > 0] = \beta x_i + \beta\lambda_i(-\gamma w_i), \tag{20}$$

where $\lambda_i(z) = \frac{\phi(z)}{1-\Phi(z)}$, with $\Phi(\cdot)$ ($\phi(\cdot)$) defining the normal cumulative (density) function. We are interested in the average marginal effect of x_{ik} on y_i, but do not observe the variable $\lambda_i(-\gamma w_i)$. The equation below shows that an OLS estimation suffers from omitted variables bias if there is any correlation between regressors in Eqs. (18) and (19):

$$\frac{\delta E[y_i|z_i^* > 0]}{\delta x_{ik}} = \beta_k - \gamma_k \rho \sigma_\varepsilon[\lambda_i^2(-\gamma w_i) - \gamma w_i \lambda_i(-\gamma w_i)]. \tag{21}$$

The Heckman (1979) correction for this problem consists of a first-stage probit of a dummy indicating selection into the sample on variables driving selection. From this selection equation it is possible estimate the omitted variable in Eq. (20) using $\lambda_i(\hat{\gamma} w_i)$. One can then estimate the original Eq. (18) including this predicted value as an extra regressor for consistent estimates of β.

We employ two strategies to deal with concerns about sample selection in our analysis. First, we try to capture the impact of deregulation on geographic diversification and sample inclusion. Several states did not permit the operation of multi-bank holding companies until the mid 1980s, and until the late 1980s there were several restrictions on BHC's ability to acquire out-of-state banks. As we noted above, the inverted U-shaped pattern in the number of banks in our sample is plausibly explained by deregulation trends affecting banking consolidation. We correct for these trends using a selection equation that includes a full set of state effects, a full set of time effects, and dummy variables indicating that a state has deregulated banking activities.[23] Our second approach speaks directly to the influence of the monetary policy on sample inclusion. We estimate a Heckman-corrected procedure that includes eight lags of the federal funds rate in the selection

[23] Our branching deregulation proxies are from Jayaratne and Strahan (1996).

equation. In both the deregulation and the federal funds Heckman procedures, we use the selection equation to predict inclusion in the sample, and then use this predicted inclusion variable as a control in the first-stage of our estimations.

The results for the Heckman corrected estimations are displayed in Table 6. In both cases, they consistently indicate that sample selection biases associated with deregulation trends and with the monetary policy cycle are unlikely to exert any significant influence on our conclusions.

5.2 Random BHC Assignments

The second selection bias we consider as potentially affecting our inferences comes from the non-randomness in the process through which bank affiliates are assigned to their particular BHCs. Mergers and acquisitions are not random events, and are thought to occur whenever it 'makes economic sense' to combine certain businesses in specific ways. Although it is still a matter of debate what is economically sensible in the conglomeration trend in the US banking industry, conceivably, multi-bank conglomerates may operate in such a way that could explain why their subsidiaries display different responses to monetary policy shocks. Of course, the only circumstance in which this may be concerning to our conclusions is under a scenario in which underlying reasons why subsidiaries display different responses to monetary policy are correlated the financial constraints of their borrowers. While it is difficult to pin down a mechanism that could systematically bias our results along those lines, we try to address this possibility in a general way.

Again, the claim is that our inferences are based on the specific sample we have and that the way the data are endogenously presented to us — rather than the workings of internal capital markets favoring bank affiliates with the best borrowers — might explain our results. To see whether the patterns in affiliate loan growth we observe are robust to changes in the structure of the data, we "intervene" in the formation of the BHCs by way of a randomization procedure. This consists of randomly re-assigning affiliates in the data to different conglomerates and estimating our two-step procedure on the randomized parent-affiliate matching. Specifically, in this exercise we use the same sample of banks used in the baseline specification, however, instead of relying on how banks have selected to a particular holding company, on a quarterly basis, we randomly assign each of these banks to one of 100 fictional holding companies. The first stage of our two-step procedure then estimates the sensitivity of subsidiary loan growth to state economic conditions with each variable measured relative to the fictional holding company mean. The second stage regressions are unchanged.[24]

[24]We acknowledge that in this exercise we are breaking the link between the bank and its particular holding

Results from the in-sample randomization are presented in Table 7, which has the same structure of Table 4 above. Most of the $\sum \phi_k$ estimates have the same sign and level of statistical significance of those displayed in Table 4, pointing to similar conclusions about a dimension of the balance sheet channel of monetary policy that is identified through data from financial conglomerates.

6 Conclusions

This paper makes two contributions to the literature on the balance sheet channel. First, we establish micro-foundations that more clearly define this transmission mechanism and yield sharp predictions about the differential response of investment to monetary policy across firm creditworthiness. Second, we improve upon the existing empirical literature by devising a strategy that effectively shuts down the lending channel in order to isolate the amplification of the effect of monetary policy on investment through firm creditworthiness. We interpret our impirical results as evidence that the balance sheet channel is certainly a part of how monetary policy works.

Our findings have a number of implications for the monetary authority. Among others, they suggest that when engaging in monetary policy, the central bank should consider the amplification effects of changes in the federal funds rate on the real economy which are generated (or exacerbated) by firm-level financial constraints. In particular, barring the presence of other asymmetries in the transmission mechanism (which we don't dispute), expansionary monetary policy should generally be more restrained during a recession than contractionary monetary policy during a boom. Asymmetries in the transmission mechanism of monetary policy over the business cycle also need to be acknowledged in forecasting future economic performance. Our findings also add to the growing literature on the role internal capital markets play in the allocation of funds within conglomerate firms, particularly in financial conglomerates. They point at need to understand in more detail the influence of conglomeration and merger waves on the impact of Federal Reserve policies on bank lending activity.

Future research will proceed along two dimensions. While we are able to effectively shut down the lending channel using bank microdata, we are unable to ascertain the marginal contribution of agency problems — as opposed to the effect of policy on default probabilities — to the amplification of monetary policy on investment. While this question is empirically challenging, the answer has

company, which requires us to strengthen our identifying assumption. While we have argued above that a parent company could smooth any residual financial constraints across subsidiaries, we must now suppose that these banks are nearly unconstrained. This assumption is stronger than the one used before but, we think, a reasonable one given our research design. Since we focus on small banks that are affiliated with very large BHCs, the obligation of the parent to assist a troubled subsidiary should validate the assumptions we need for this particular robustness check.

potentially important welfare implications. We also note that while we have uncovered evidence of a balance sheet channel in this paper, we have done little to ascertain its importance relative to other mechanisms of monetary policy transmission. Understanding the relative importance of this transmission mechanism, we believe, is a central issue for applied work in this area.

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Appendix A: Mathematical Proofs

Proof of Lemma 1

Define $P = R + \mu\frac{\delta R}{\delta\mu}$. Note that for the first-order conditions to characterize the maximum value of μR, P must be decreasing in μ. Since $M < 0$, it follows that the actual choice of μ is smaller than the value which simply maximizes assets; i.e., there is excessive risk-taking. The magnitude of the incentives to shift risk is increasing in the value of assets at risk $r_f(w-c)$ and decreasing in the probability of firm survival μ.

Proof of Lemma 2

We use the following from the definition of $M = r_f\frac{c-w}{\mu}$: (1) $M_{r_f} = \frac{c-w}{\mu} < 0$; (2) $M_c = \frac{r_f}{\mu} > 0$; (3) $M_w = \frac{-r_f}{\mu} < 0$; (4) $M_\mu = r_f\frac{w-c}{\mu^2} > 0$; (5) $M_{r_fc} = \frac{1}{\mu} > 0$; (6) $M_{wc} = 0$; (7) $M_{\mu c} = \frac{-r_f}{\mu^2} < 0$; (8) $M_{r_fw} = \frac{-1}{\mu} < 0$; (9) $M_{\mu w} = \frac{r_f}{\mu^2} > 0$. In addition, we use $P_\mu + M_\mu < 0$ which follows from the second-order conditions that guarantee the first-order conditions characterize a maximum. Finally, we use the assumptions $P_{r_f} = 0$, $P_c = 0$, and $P_{\mu w} \geq 0$, the latter of which follows from that $R_{\mu w} \geq 0$. Using these inequalities, it is possible to sign each of (a) through (g) as follows: (a) $\mu_{r_f} = \frac{-M_{r_f}}{P_\mu+M_\mu} < 0$; (b) $\mu_w = \frac{-M_w}{P_\mu+M_\mu} < 0$; (c) $\mu_c = \frac{-M_c}{P_\mu+M_\mu} > 0$; (d) $\mu_{r_fw} = \frac{-M_{r_fc}-\mu_{r_f}M_{\mu c}}{P_\mu+M_\mu} > 0$; (e) $\mu_{wc} = \frac{-\mu_w M_{\mu c}}{P_\mu+M_\mu} > 0$; (f) $\mu_{r_fw} = \frac{-M_{r_fw}-\mu_{r_f}M_{\mu w}}{P_\mu+M_\mu} < 0$; (g) $\mu_{r_fwc} = \frac{-\mu_{r_fw}M_{\mu c}-\mu_w M_{\mu r_fc}-\mu_{wc}M_{\mu r_f}}{P_\mu+M_\mu} > 0$.

Proof of Lemma 3

The concavity of R in w guarantees that the firm's optimal choice of loan size w is decreasing in the marginal cost MC faced by the firm. In the absence of private information or limited liability, firm risk choice no longer depends on loan size w, so the second term on the right-hand side of Eq. (5) disappears. Lemma 1 indicates that agency problems induce firms to take excessive risk, which increases the ratio of r_f to μ. It follows that since the marginal cost of funds is higher, firm investment must be lower.

Proof of Proposition 2

The proof involves signing each of the seven terms involved in $\frac{\delta^2 MC}{\delta r_f \delta c}$. Using the results from Lemma 2, it follows that: (1) $\frac{-1}{\mu^2}\mu_c < 0$; (2) $\frac{-r_f}{\mu^2}\mu_{r_fc} < 0$; (3) $\frac{2r_f}{\mu^3}\mu_c\mu_{r_f} < 0$; (4) $\mu_{wc}M_{r_f} < 0$; (5) $\mu_w M_{r_fc} < 0$; (6) $\mu_{r_fwc}S < 0$; (7) $\mu_{r_fw}S_c < 0$. Since each of these seven terms is negative the proof is complete.

Appendix B: Construction of Panel Bank Microdata

All of the bank-level data used in the analysis is derived from the Federal Reserve's *Report of Condition and Income (Call Reports)*. We employ a version of the *Call Reports* cleaned by the Banking Studies Function of the Federal Reserve of New York, and thus may differ from the data made publicly available online at the Federal Reserve Bank of Chicago. We collect quarterly data on insured commercial banks over 1976:I-1998:II. This requires the bank type (RSSD9331) be identified as a "commercial bank" by having a value equal to one and the reporting level code (CALL8786) identified as "Not Applicable" by having a value equal to zero. FDIC-insured banks are identified by the deposit insurance status (RSSD9424) reflecting the FDIC as the bank's insurer by having a value of 1.

There are many well-known reporting discontinuities in the data and rely on notes by Anil Kashyap and Jeremy Stein published online by the Federal Reserve Bank of Chicago to construct consistent times series. Each of the variables used in our analysis are constructed as follows:

Loans. The aggregate gross book value of total loans and leases before deduction of valuation reserves (RCFD1400) includes: a) acceptances of other banks and commercial paper purchased in open market; b) acceptances executed by or for account of reporting bank and subsequently acquired by it through purchase or discount; c) customers' liability to reporting bank on drafts paid under letter of credit for which bank has not been reimbursed; and d) "cotton overdrafts" or "advances", and commodity or bill of lading drafts payable upon arrival of goods against which drawn for which reporting bank has given deposit credit to customers. Also includes: a) paper rediscounted with Federal Reserve or other banks; and b) paper pledged as collateral to secure bills payable, as marginal collateral to secure bills rediscounted, or for any other purpose. Before 1984:I, this item does not include lease-financing receivables, so in order to ensure continuity, total loans must be computed as the sum of total loans (RCFD1400) and lease-financing receivables (RCFD2165) for the period prior to 1984:I.

Bad Loans. The measure of loan performance employed avoids managerial discretion in reporting losses. Bad loans are defined as the ratio of the sum of loans not accruing (RCFD1403) and loans over 90 days late (RCFD1407), divided by total loans. Loans not accruing (RCFD1403) measures the outstanding balances of loans and lease financing receivables that the bank has placed in nonaccrual status. Also includes all restructured loans and lease financing receivables that are in nonaccrual status. Loans and lease financing receivables are to be reported in nonaccrual status if: a) they are maintained on a cash basis because of deterioration in the financial position of the borrower, or b) principal or interest has been in default for a period of 90 days or more unless the obligation is both "well secured" and "in the process of collection". Loans over 90 days late (RCFD1407) measures loans and lease financing receivables on which payment is due and unpaid for 90 days or more. The measure includes all restructured loans and leases after 1986:II, which was reported separated as Renegotiated "Troubled" Debt (RCFD1404).

Capitalization. The capital-to-asset ratio is computed as equity (RCFD3210) divided by total assets (RCFD2170). Equity capital (RCFD3210) is the sum of "Perpetual Preferred Stock and Related Surplus", "Common Stock", "Surplus", "Undivided Profits and Capital Reserves", "Cumulative Foreign Currency Translation Adjustments" less "Net Unrealized Loss on Marketable Equity Securities".

Deposits. Total deposits are measured using item RCFD2200.

Bank Size. At each quarter, all banks in the data are ranked according to their total assets (RCFD2170). Small and large banks are identified using the 95^{th} percentile of the asset distribution as a size cut-off.

Multi-Bank Holding Company Affiliation. Affiliation with a multi-bank holding company is identified the number of insured commercial banks that have a common regulatory direct holder (RSSD9348) or high holder (RSSD9379) being larger than one.

Large Multi-Bank Holding Company Affiliation. Affiliation with a large multi-bank holding company is determined by the holding company owning more than one bank and either the regulatory direct holder or regulatory high holder owning at least one subsidiary considered to be a large commercial bank.

Large Multi-State Bank Holding Company Affiliation. Affiliation with a large multi-state bank holding company is determined by the holding company being a large multi-bank holding company that has two small subsidiaries operating in separate states (RSSD9210).

Appendix C: Measures of Monetary Policy

The monetary policy measures we use are standard in the literature. All of our policy measures are constructed with series available from the Federal Reserve system's data bank.

Fed Funds. We use the monthly series of effective annualized Fed funds rates from the Board of Governors' Release H.15. Bernanke and Blinder (1992) argue that this rate captures the stance of monetary policy well because it is sensitive to shocks to the supply of bank reserves. The Fed funds rate is the prevalent measure of monetary policy in related empirical work. However, the adequacy of this proxy has been questioned for periods when the Fed's operating procedures were modified (e.g., the Volker period).

Funds-Bill. Motivated by Bernanke and Blinder (1992), this is computed as the difference between the effective annual Fed funds rate and the rate on 10-year Treasury bills. These series are gathered from Board of Governors' Release H.15.

CP-Bill. This is computed as the difference between the rates paid on six-month prime rated commercial papers and 180-day Treasury bills. These series are also available from Board of Governors' Release H.15, but the paper series is discontinued in 1997:I. The paper rates are given as discount rates and the Treasury bill as coupon equivalent rates. We transform both series into effective yield rates before computing the difference. Bernanke (1990) argues that CP-Bill increases capture Fed tightenings since banks will cut loans and corporations are forced to substitute commercial paper for bank loans.

NonBorrowed. Measured as the log change in non-borrowed reserves. We perform this computation using data from the Federal Reserve's FRED data bank.

Strongin. Strongin (1995) argues that previous studies attempting to identify the stance of monetary policy fail to properly address the Fed's strategy of accommodating reserve demand shocks. Strongin measures the portion of non-borrowed reserves growth that is orthogonal to total reserve growth. It equals the residual of a linear regression of total reserves on non-borrowed reserves, where both series are normalized by a 24-month moving average of total reserves prior to the estimation. We perform this computation using data from the Federal Reserve's FRED data bank.

Table 1: Banks Part of Large Multi-State Holding Companies

Year	Quarter I	II	III	IV	Total
77	-	195	194	195	584
78	195	195	196	196	782
79	196	196	198	197	787
80	198	199	199	200	796
81	202	202	204	195	803
82	197	197	198	198	790
83	208	213	206	195	822
84	206	189	200	189	784
85	237	234	293	286	1,050
86	320	357	411	576	1,664
87	665	778	739	801	2,983
88	892	883	854	823	3,452
89	862	859	871	849	3,441
90	835	800	794	751	3,180
91	733	762	745	722	2,962
92	693	713	724	717	2,847
93	684	737	717	713	2,851
94	695	706	631	656	2,688
95	596	597	599	575	2,367
96	578	520	490	480	2,068
97	468	430	-	-	898
Total	9,660	9,962	9,463	9,514	38,599

Table Notes: The table illustrates the number of small banks that are affiliated with a large multi-state bank holding company in each quarter and contain enough consecutive quarters of data (5) to be used in the analysis below.

Table 2: Descriptive Statistics on Small Banks

	In the Sample	Not in the Sample
$\Delta ln(Loans)_{ijt}$	0.0157	0.0211
	(0.0764)	(0.0680)
$BadLoans_{ijt}$	0.0144	0.0156
	(0.0259)	(0.0267)
$ln(Assets)_{ijt-1}$	11.4992	10.3804
	(0.8750)	(0.9803)
$(Equity/Assets)_{ijt-1}$	0.0811	0.0912
	(0.0406)	(0.0340)
$(Securities/Assets)_{ijt-1}$	0.2378	0.2987
	(0.1406)	(0.1447)
$\overline{\Delta ln(Loans)_{ij}}$	0.0240	0.0245
	(0.0222)	(0.0189)
$\overline{BadLoans_{ij}}$	0.0118	0.0148
	(0.0143)	(0.0119)
$\Delta ln(Loans)_{ijt} - \overline{\Delta ln(Loans)_{ij}}$	-0.0084	-0.0034
	(0.0748)	(0.0668)
$BadLoans_{ijt} - \overline{BadLoans_{ij}}$	0.0026	0.0008
	(0.0222)	(0.0235)
N	38,599	926,845

Table Notes: The table refers to the sample mean and standard deviation for a number of variables in the population of small insured commercial banks. The first column refers to small banks that are part of large multi-state bank holding companies while the second column refers to all other small banks. Reading down, the measures include quarterly loan growth, bad loans as a fraction of total loans, one lag of log bank assets, one lag of bank leverage, one lag of bank liquidity, average quarterly loan growth and bad loans for the bank, and the difference in quarterly loan growth and bad loans from its long-run average.

Table 3: Local Economic Conditions and Bank Loan Quality

Dependent Variable	$\Omega_{ijt}^{BadLoans}$	$\Omega_{ijt}^{\widetilde{BadLoans}}$
A. Borrower's Balance Sheet proxyed by $\Delta ln(YGap_{ijt})$		
	-0.0244	-0.0289
	(0.0141)	(0.0099)
B. Borrower's Balance Sheet proxyed by Ω_{ijt}^{YGap}		
	-0.0420	-0.0286
	(0.0168)	(0.0123)
N	36,090	36,090

Table Notes: The table refers a regression of a function of bank-level bad loans on on state economic activity and other covariates. This measure of economic activity includes the state income gap in the first row and the difference in state income gap from the average gap faced by banks in the subsidiary in the second row. In the first column the dependent variable is the difference in bad loans from the holding company mean while in the second column it is this variable differenced again against its long-run mean. The coefficient on state economic activity is reported as well as standard errors, which have been corrected for heteroskedasticity.

Table 4: Monetary Policy and the Balance Sheet Channel

First Stage Dep. Variable	Measure of Monetary Policy				
	Fed Funds	CP-Bill	Funds-Bill	NonBorrow	Strongin
A. Borrower's Balance Sheet proxyed by $\Delta ln(YGap_{ijt})$					
Ω_{ijt}^{Loans}	0.041	0.200	0.036	0.941	0.793
	(0.020)	(0.021)	(0.246)	(0.604)	(0.185)
$\Omega_{ijt}^{\widetilde{Loans}}$	0.042	0.143	0.054	2.125	0.931
	(0.009)	(0.127)	(0.039)	(0.194)	(0.181)
B. Borrower's Balance Sheet proxyed by Ω_{ijt}^{YGap}					
Ω_{ijt}^{Loans}	0.032	0.215	0.039	2.184	1.070
	(0.063)	(0.024)	(0.323)	(0.410)	(0.009)
$\Omega_{ijt}^{\widetilde{Loans}}$	0.031	0.100	0.055	5.166	0.942
	(0.065)	(0.266)	(0.124)	(0.013)	(0.096)

Table Notes: The table refers to the second stage regression described in the text. The dependent variable is the average sensitivity of bank loan growth to the state economic activity, while explanatory variables include 8 lags of monetary policy measures, 8 lags of aggregate output growth, a time trend, and quarter effects. The estimation period is 1977:II through 1998:II. The table reports the sum of coefficients on the 8 lags of each measure of monetary policy and the *p*-value for the hypothesis test that this sum is no different from zero. Each of the last five columns refers to specifications characterized by the employed measure of monetary policy. In Panel A, borrowers' balance sheet strengh is proxyed by $\Delta ln(YGap_{ijt})$, while in Panel B the relevant proxy is Ω_{ijt}^{YGap}.

Table 5: Cumulative Balance Sheet Effect of the Funds Rate on Lending

First Stage	Cumulative Lags of the Fed Funds Rate							
Dependent Variable	1	2	3	4	5	6	7	8
A. Borrower's Balance Sheet proxyed by $\Delta ln(YGap_{ijt})$								
Ω_{ijt}^{Loans}	0.017	0.024	0.021	0.024	0.026	0.029	0.039	0.041
	(0.175)	(0.144)	(0.239)	(0.173)	(0.142)	(0.102)	(0.034)	(0.020)
$\widetilde{\Omega_{ijt}^{Loans}}$	0.016	0.023	0.022	0.026	0.026	0.030	0.039	0.042
	(0.149)	(0.107)	(0.162)	(0.124)	(0.137)	(0.112)	(0.028)	(0.009)
B. Borrower's Balance Sheet proxyed by Ω_{ijt}^{YGap}								
Ω_{ijt}^{Loans}	0.023	0.024	0.019	0.025	0.027	0.029	0.036	0.032
	(0.133)	(0.158)	(0.299)	(0.157)	(0.087)	(0.049)	(0.049)	(0.063)
$\widetilde{\Omega_{ijt}^{Loans}}$	0.019	0.020	0.017	0.022	0.022	0.025	0.033	0.031
	(0.118)	(0.147)	(0.327)	(0.223)	(0.210)	(0.160)	(0.083)	(0.065)

Table Notes: The table refers to the second-stage regression described in the text. The dependent variable is the average sensitivity of bank loan growth to the state economic activity, while explanatory variables include 8 lags of monetary policy measures, 8 lags of aggregate output growth, a time trend, and quarter effects. The estimation period is 1977:II through 1998:II. The table reports the sum of coefficients on lags of the funds rate and the p-value for the hypothesis test that this sum is no different from zero. Each of the last eight columns refers to statistics characterized by the number of lags over which to sum. In Panel A, borrowers' balance sheet strengh is proxyed by $\Delta ln(YGap_{ijt})$, while in Panel B the relevant proxy is Ω_{ijt}^{YGap}.

Table 6: Heckman Sample Selection Correction

First Stage	Measure of Monetary Policy				
Dep. Variable	Fed Funds	CP-Bill	Funds-Bill	NonBorrow	Strongin
A. Branching Variables in Selection Equation					
Ω_{ijt}^{Loans}	0.039	0.212	0.072	1.602	0.886
	(0.047)	(0.026)	(0.088)	(0.465)	(0.077)
$\widetilde{\Omega_{ijt}^{Loans}}$	0.032	0.157	0.065	1.972	0.872
	(0.094)	(0.093)	(0.089)	(0.280)	(0.084)
B. Lagged Funds Rate in Selection Equation					
Ω_{ijt}^{Loans}	0.034	0.145	0.045	0.874	0.769
	(0.024)	(0.061)	(0.259)	(0.624)	(0.091)
$\widetilde{\Omega_{ijt}^{Loans}}$	0.029	0.111	0.044	1.375	0.836
	(0.047)	(0.155)	(0.204)	(0.393)	(0.072)

Table Notes: The table refers to the second stage regression described in the text. The dependent variable is the average sensitivity of bank loan growth to the state economic activity, while explanatory variables include 8 lags of monetary policy measures, 8 lags of aggregate output growth, a time trend, and quarter effects. The estimation period is 1977:II through 1998:II. The table reports the sum of coefficients on the 8 lags of each measure of monetary policy and the p-value for the hypothesis test that this sum is no different from zero. Each of the last five columns refers to specifications characterized by the employed measure of monetary policy. Each specification uses the state income gap in the first-stage regression. In Panel A we use dummies for state branching deregulation in the selection equation while in Panel B the we use eight lags of the federal funds rate

Table 7: Random Assignment of Bank Holding Companies

First Stage Dep. Variable	Measure of Monetary Policy				
	Fed Funds	CP-Bill	Funds-Bill	NonBorrow	Strongin
A. Borrower's Balance Sheet proxyed by $\Delta ln(YGap_{ijt})$					
Ω_{ijt}^{Loans}	0.038	0.214	0.038	-6.564	1.890
	(0.023)	(0.061)	(0.499)	(0.249)	(0.001)
$\Omega_{ijt}^{\widetilde{Loans}}$	0.041	0.241	0.077	-4.260	2.577
	(0.022)	(0.076)	(0.130)	(0.394)	(0.000)
B. Borrower's Balance Sheet proxyed by Ω_{ijt}^{YGap}					
Ω_{ijt}^{Loans}	0.043	0.240	0.028	-7.355	1.869
	(0.014)	(0.041)	(0.636)	(0.229)	(0.002)
$\Omega_{ijt}^{\widetilde{Loans}}$	0.045	0.265	0.073	-4.362	2.526
	(0.015)	(0.056)	(0.146)	(0.406)	(0.000)

Table Notes: The table refers to the second stage regression described in the text. The dependent variable is the average sensitivity of bank loan growth to the state economic activity, while explanatory variables include 8 lags of monetary policy measures, 8 lags of aggregate output growth, a time trend, and quarter effects. The estimation period is 1977:II through 1998:II. The table reports the sum of coefficients on the 8 lags of each measure of monetary policy and the p-value for the hypothesis test that this sum is no different from zero. Each of the last five columns refers to specifications characterized by the employed measure of monetary policy. In Panel A, borrowers' balance sheet strengh is proxyed by $\Delta ln(YGap_{ijt})$, while in Panel B the relevant proxy is Ω_{ijt}^{Y}.

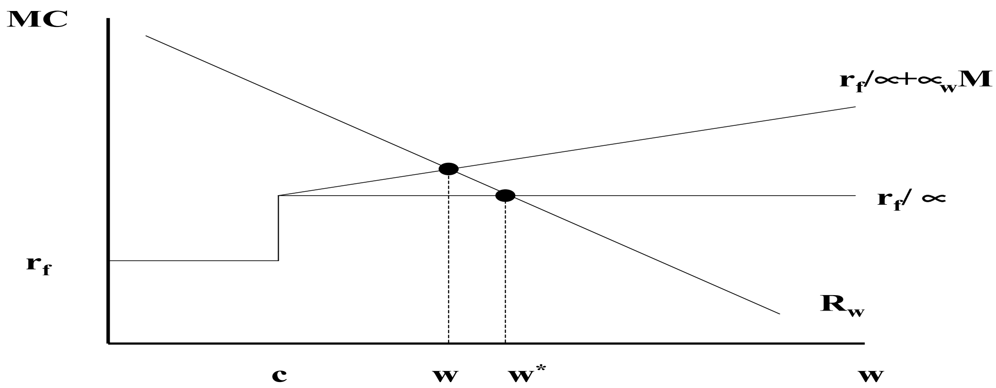

Figure 1: Equilibrium Investment

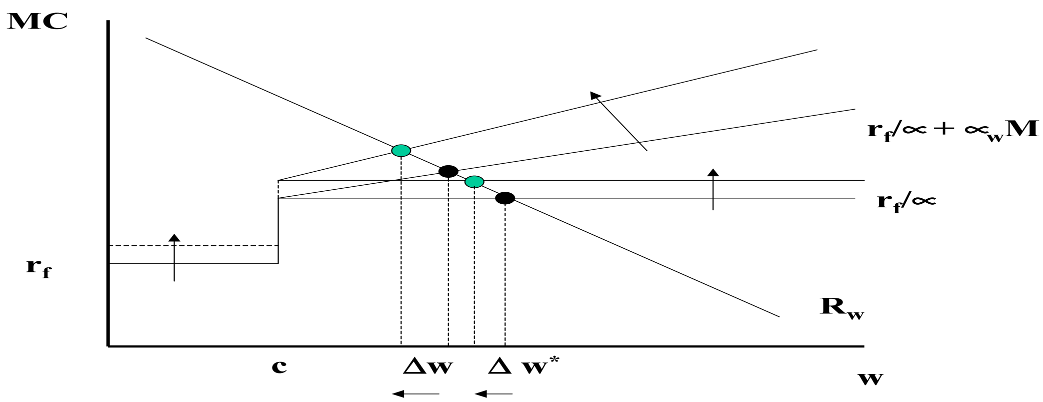

Figure 2: Investment and Monetary Pollicy

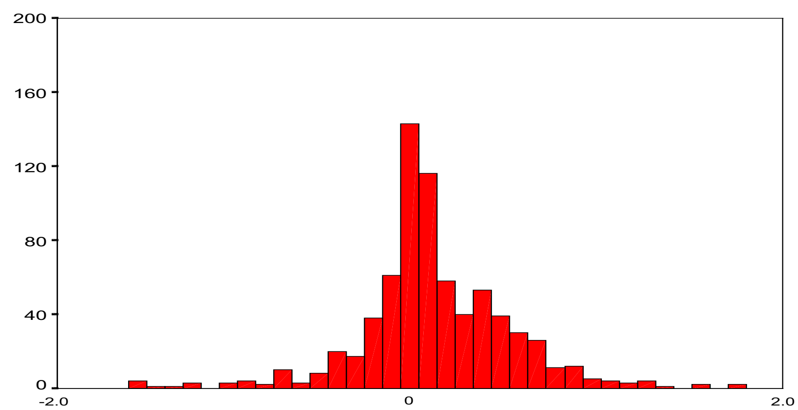

Figure 3: $\sum \gamma$, various first-stage regressions. The bin of the histogram is 0.1