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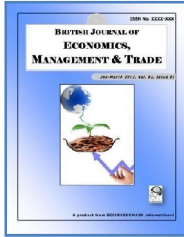
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Bank Lending Channel Effectiveness and Loan Sales in the US

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Authors' contributions

This work was carried out in collaboration between all authors. Author MRJ wrote the first draft of the manuscript. Author SKK revised literature and statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

This paper examines whether banks that sell loans in the secondary market respond differently to a monetary policy innovation from those that do not engage in loan sales. We answer this question by measuring the policy response while controlling for loan sales activities. Using a simple theoretical model and U.S. bank-level Call Report longitudinal data for the period 1991Q1-2008 Q4, we conduct a dynamic panel regression analysis. We find that the long-run response to a typical policy shock is three times greater for mid-size banks engaging in loan sales. Given the increase in proportion of banks engaging in loan sales, this finding has strong implications for policy makers and bank industry volatility.

Keywords: Securitization; loan sales; monetary policy; bank lending channel; dynamic panel regression.

1. INTRODUCTION

This paper investigates how off-balance sheet bank activities affect the transmission of monetary policy, in particular, the bank lending channel. Since deregulation of the banking

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sector, improvements in data-processing and telecommunications, and the implicit subsidies from Government Sponsored Enterprises (GSE's), banks have increasingly changed their business model of "originate and hold" loans to "originate and sell" by participating in off-balance sheet activities such as securitizing mortgage assets and loan sales. The growth in this area of bank activity has been unprecedented, which raises the question of how the efficacy of the bank lending channel has changed over time following this growth of securitization. Securitization has clearly affected credit markets by transforming otherwise illiquid assets into liquid, tradable securities. Increasingly banks are using loan sales to finance their lending, with over 50% of mortgage loans being sold and the funds recirculated within the lending institution [1]. Given that loan sale activity varies across banks, monetary policy effects may also vary across banks for this reason. This paper examines the types of banks that have been most engaged in securitization and their behavior under stimulus or contraction of monetary policy. Results indicate that medium sized banks engaged in loan sales are *two to three times* more sensitive to monetary contraction relative to non-selling banks.

1.1 Literature Review: Loan Sales and the Transmission of Monetary Policy

There are several channels of monetary policy transmission to the real side of the economy. Two channels are of particular interest here; the interest rate channel and the bank lending channel. The interest rate channel operates through prices; specifically, the response of investment demand to changes in interest rates following an open market sale of securities by the central bank [2,3,4]. When bank reserves fall relative to deposits, banks must reduce deposit holdings causing nominal and real interest rates to rise. Likewise, it is argued that the decline in deposits comes also through the increase in their opportunity cost with respect to other risk-free assets [5]¹. As the opportunity cost of investment increases, investment declines and subsequently real economic activity falls. The supply of bank loans is irrelevant to the interest rate channel since firms who borrowed from banks before the monetary contraction can still borrow in the bond or commercial paper market. That is, bank loans and other forms of credit are assumed perfect substitutes.

Unlike the interest rate channel, the bank lending channel operates on the asset side of banks' balance sheets; a monetary contraction causes the supply of bank loans to fall (see, for example: [6,7,8]). Following a monetary contraction, banks must alter their asset composition. Banks have several options to deal with a policy induced decline in bank reserves; by acquiring non-reservable loanable funds, such as CD's or by decreasing their holdings of securities. If banks are unable to shield their loan supply by costlessly substituting non-reservable liabilities for reservable deposits, or decreasing securities, then banks reduce their loans². Kashyap and Stein [7] argued that an open market sale of securities by the Fed increases the bank's cost of funds causing the supply of loans to shift leftwards. Further, during monetary contraction asymmetric information worsens and banks become more cautious when lending funds.

In order for the lending channel to propagate and amplify the effects of monetary policy, two events must occur: first, banks must reduce the availability of credit to borrowers; and

¹See [5] for example. *Households substitute bonds for deposits. A rising nominal interest rate results in higher real rates due to price stickiness in the economy.*

²*The liability side of the balance sheet may absorb a portion of the monetary contraction, as larger banks have the option of issuing uninsured CDs or bonds to compensate for the drop in deposits [9].*

second, bank dependent borrowers must not be able to find alternate sources of funding. When denied bank credit, these borrowers will reduce investment, employment and output.

Asset size has been shown repeatedly to be a crucial determinant of bank behavior. Kashyap and Stein [7,10] found that the lending channel operates primarily through small, liquidity constrained banks because these banks would have more difficulty raising non-reservable liabilities compared to large banks. Kishan and Opiela [11] found that small, poorly capitalized banks are more responsive to monetary contraction compared to large, well-capitalized banks. Consequently, small banks are more likely to reduce loan supply in response to a reduction in reserves. DeYoung and Duffy [12] argued that the changes occurring in the banking industry tend to benefit larger banks rather than smaller banks. Another important difference in the bank operation across size categories is in the volatility of loan returns. Corbae and D'Erasmus [13] pointed out that small banks experience greater loan return volatility, which leads to endogenous adjustment of the balance sheet, with a greater reliance on securities to account for this greater risk.

1.2 The Development of Loan Sales and Securitization

Traditionally, a bank originates (issues) a loan which it holds on its balance sheet until maturity. Increasingly, banks are deviating from this "traditional" behavior and selling loans on their balance sheet, in part or in entirety, to other institutions. A bank may want to remove loans from its balance sheet for a variety of reasons, such as; meeting liquidity requirements, reducing risk-based capital requirements, or to simply reduce the overall costs of servicing and financing loans. Banks can manage their risk exposure by selling risky, leveraged loans. In fact, Drucker and Puri [14] found that it is the risky, leveraged, loans that are most commonly sold in the secondary loan market. Another reason banks sell loans is to diversify their loan portfolio, which reduces risk. Demsetz [15] argued that banks also engage in loan selling because they have a comparative advantage in originating loans and other banks buying loans have a comparative advantage in funding those loans. Banks with extensive branching and access to diversified loan originations are less likely to engage in loan sales or purchases. Demsetz [15] also found that banks with strong reputations or banks belonging to bank holding companies are more likely to enter into the secondary loan market suggesting a "reputational" barrier to market entry.

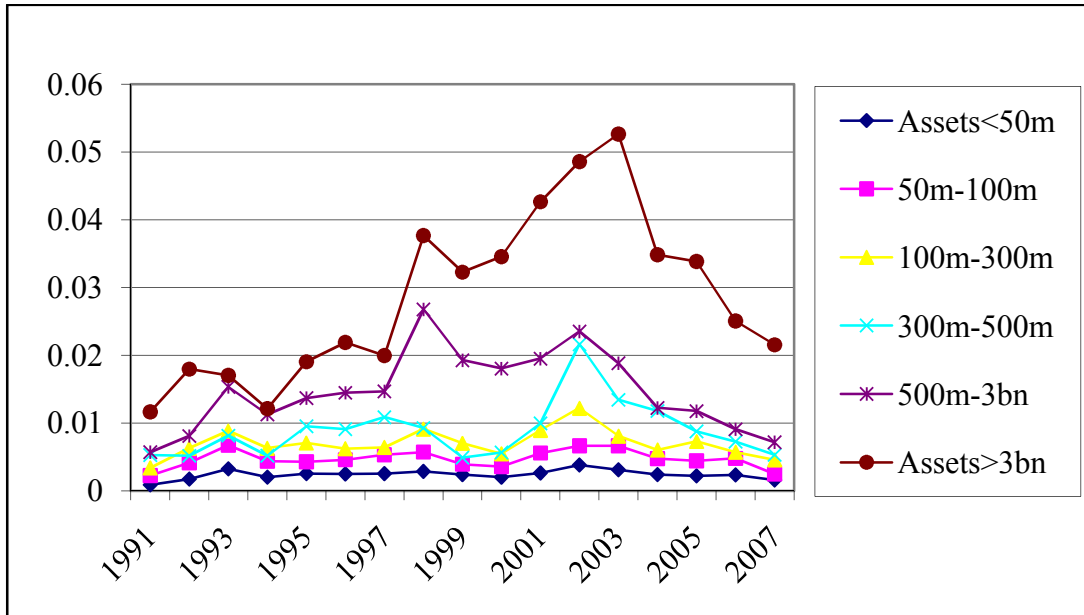


Fig. 1. Loans held for sale as a proportion of total loans, by bank size

Source: Call Reports FFIEC 031 and FFIEC 041.

As Fig. 1 above indicates, banks with assets in excess of \$500 million are more likely to engage in loans sales as a proportion of total loans. This finding is consistent with Demsetz [15] that larger banks have greater access to the secondary loan market.

According to [14], banks remove loans from their balance sheet through loan sales, syndication, and/or asset securitization. The data suggests that loan sales are typically anticipated by the bank at origination since 60 percent are sold within one month of origination and 90 percent are sold within one year. These loans are typically sold to non-banks such as pension funds, investment banks, finance companies, etc. Usually these loans have tighter restrictive covenants tied to the firm's financial data. These covenants mitigate the costs associated with adverse selection and moral hazard making the loan more liquid in the secondary market [14].³ With loan syndication, the lead bank negotiates the terms of the loan with the borrower and manages the loan. The lead bank then sells pieces of the loan to participant banks at origination; consequently participant banks essentially fund fractions of the loan without being involved in the daily maintenance of the loan. As with securitized loans, the secondary market for syndicated loans has boomed. According to [14], US non-financial firms raised \$1.5 trillion in loan syndications in 2005. The secondary loan sales market grew from \$8 billion in 1991 to \$176.3 billion in 2005. Loan syndication differs from securitization by the size of the loan: syndicated loans involve large loan sizes but securitization involves many small sized loans [16].

A bank securitizes an asset by pooling similar financial assets (based on term, structure, and credit characteristics) into asset-backed tradable securities to be sold on the secondary

³ Typical loan covenants include the borrower maintaining a minimum net worth, not exceeding maximum leverage ratio or restrictions on dividend payments. Additional covenants may include that proceed from equity or sales be applied to the reducing the principal.

market. The cash-flow generated by the repayment of the principal and/or interest from those assets provides the return to the investor buying the security. Securitization also allows banks or any financial institution to convert otherwise illiquid assets such as mortgages into liquid, tradable assets.

The market for mortgage- backed securities (MBS) developed in the 1970's following the establishment of the government sponsored enterprises (GSE), Federal National Mortgage Association (Fannie Mae), Government National Mortgage Association (Ginnie Mae), and the Federal Home Loan Mortgage Corporation (Freddie Mac). Fannie Mae was originally created to provide mortgages for low to middle income households. Freddie Mac was established to provide liquidity for the residential mortgage market. These agencies do not originate loans but purchase pooled mortgages from banks in the primary market and issue and guarantee securities in the secondary market. Fannie Mae and Freddie Mac guarantee timely payments on the security for a fee of 20 basis points on the principal. In order for the mortgage to be included in the pool of loans for the GSE's, the mortgage must meet certain criteria. In 1980 the residential mortgage market consisted of \$1.1 trillion in obligations of which Fannie Mae and Freddie Mac held or securitized 7%. By 2003 the mortgage market expanded to \$7.7 trillion of which Fannie Mae and Freddie Mac held or securitized 47% [17]. Since 1980, the secondary market expanded to other asset-backed securities (ABS) such as automobile loans, commercial loans, credit card receivables, boat loans, etc. It is not surprising that the secondary market for loans sales has exploded following the establishment of these GSE's since these agencies are responsible for lowering the cost of securitizing assets.

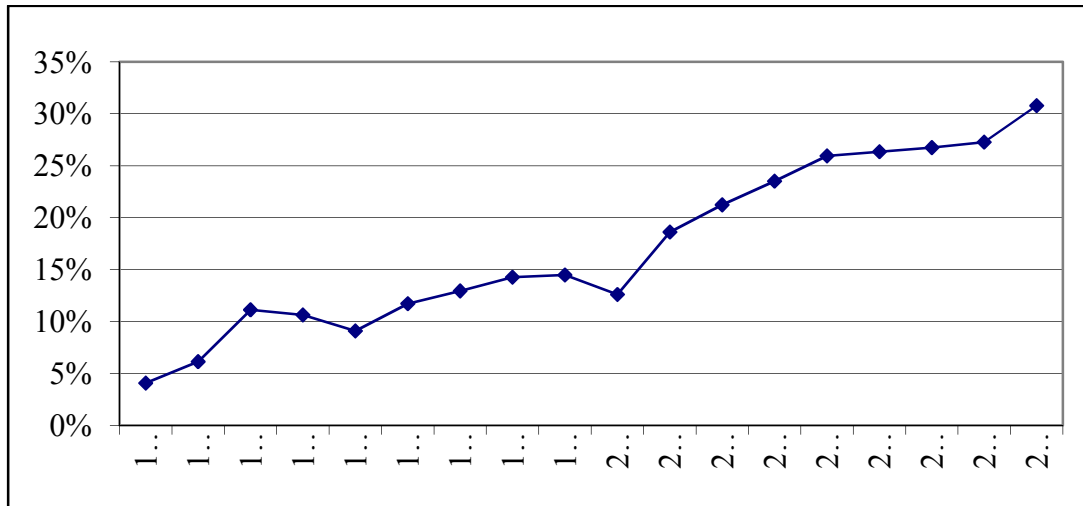


Fig. 2. Proportions of US banks with non-zero net gains from loan sales

Source: Call Reports FFIEC 031 and FFIEC 041.

As Fig. 2 indicates, the proportion of banks engaged in loan sales increased steadily during the 1990's. Selling loans became popular because it was profitable to do so and because of an increase in the ease with which banks could sell loans to Fannie Mae or Freddie Mac. Fig. 3 below shows that the ratio of the net gain from loan sales to non-interest income increased rapidly from 2000 to 2004 for all bank asset sizes. However, the sharpest rise came from the upper-medium sized banks with real assets of \$300 million-\$500 million. The

gain from loan sales relative to non-interest income declines sharply from 2007 following the sub-prime mortgage credit crunch.

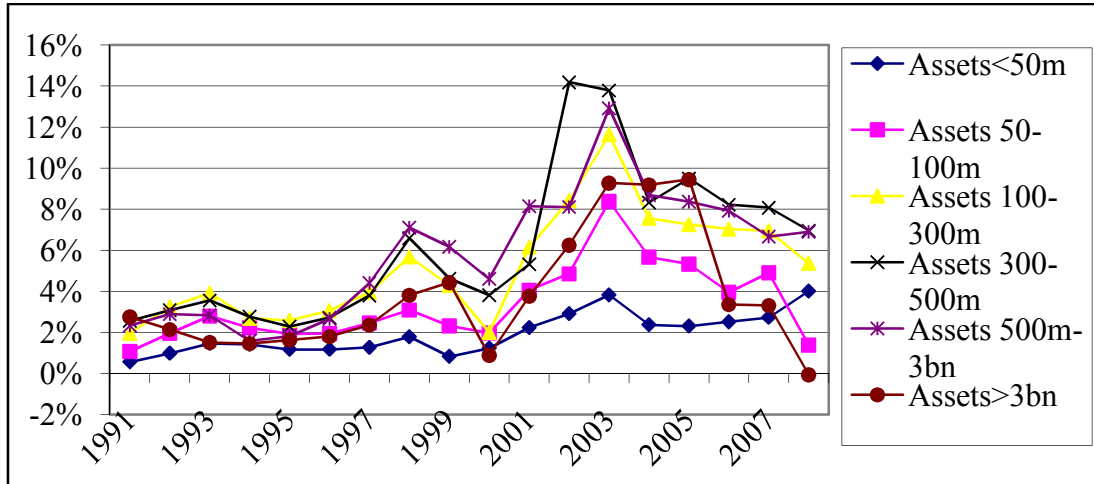


Fig. 3. Net gain from loan sales as percent of all non-interest income, by bank size
 Source: Call Reports FFIEC 031 and FFIEC 041.

1.3 Loan Sales and the Bank Lending Channel

It is unarguable that banks play a special role in the economy. Many small to medium sized firms rely on bank credit because they cannot raise funds externally in capital markets or because asymmetric information makes raising external funds more costly. An important question is how monetary policy is transmitted via the bank lending channel to the economy given the change in the banking business model. Pennacchi [18] stated that loan sales allow some banks to finance some loans less expensively than other traditional means such as deposits or issuing equity simply because banks can avoid the costs associated with holding additional required reserves or capital. Strahan[16] further argued that deposits have become less important as a source of bank funds for lending to small to medium sized firms. There has been a fundamental shift in the way in which banks operate from funding illiquid loans with liquid deposits, to offering cash on demand through credit enhancement, by transforming illiquid assets into liquid, off-balance sheet loans. Further, banks are able to fund risky loans using the proceeds from loan sales even if the bank's risk-based capital requirements are low since banks can simply sell the risky loans [14]. Given that deposits are becoming less important as a source of funding for banks, one may suspect that this would weaken the effects of the bank lending channel transmission of monetary policy. Loan sales help relax the funding constraints banks face by allowing banks to raise funds and share credit risk with other non-banks.⁴ The bank lending channel hinges on the assumption that some banks cannot replace a decline in deposits and reserves by simply issuing other non-reservable liabilities such as CD's or equity, so the market supply of credit falls. However, in the event of a monetary contraction, and a subsequent fall in reserves and deposits, banks can sell existing loans to fund additional loans potentially maintaining the supply of credit. If however, the secondary market for loan sales or securitized assets

⁴Drucker and Puri [14] argued that the majority of loans purchased are by non-bank institutions which do not originate loans in the primary market.

freezes, as in 2008 to 2011, the bank lending channel of policy transmission will become stronger as banks lose their capacity to sell loans when the secondary loan sales market becomes less liquid.

Using annual bank-level data from 1999-2005 for Euro Area banks, Altunbas, Gambacorta and Marques [19] found that securitization reduces the effectiveness of the bank lending channel. However, their result is heavily dependent on the business cycle. During business cycle up-swings the effect is stronger compared to cycle down-swings. Also, they find that monetary contractions have a greater effect on banks with risky credit portfolios, as measured by loan loss provisions and expected default frequency. Two key concerns are that the data in their study only covers one business cycle, and that the observations are annual which may obscure some of the banks responses to a monetary contraction. An additional concern is that securitization has been increasing and only began to decline recently which does not provide much variability during the 1999-2005 periods.

Using a “securitizability index” constructed across banks over time, which measures the potential level of securitization, [20] showed that securitization acts as a substitute for traditional liquid funds on banks’ balance sheets. Loutskina [20] then showed that rising *potential* securitization activity is associated with a smaller response to exogenous cost of funds shocks.

Using US bank balance sheet data from the Call Reports, this paper examines how the growth of actual loan sales affects a bank’s loan response to monetary contractions. This dataset is quarterly and spans two and a half decades, with a regression sample which spans the period 1994:Q1 to 2008:Q4.

Hobijn and Ravenna [21] developed a DSGE monetary transmission model that introduces loan sales and securitization, with a focus on the impact of market distortions due to encouraging sub-prime lending. While interesting, the underlying question of how loan sales in general impact the efficacy of policy is not addressed.⁵

2. METHODOLOGY

2.1 A Bank Behavior Model with Loan Sales

In order to establish how a change in bank level participation in loan sales will alter the strength of the bank lending channel, a variation of the Klein-Monti model is employed, which provides an industrial organization approach to bank behavior. The basis of the model is the constrained profit maximization problem of an individual banking firm in a duopoly setting. Each of the two banks are assumed to have only two assets, Loans (L_i), and Reserves (R_i). Demand Deposits (D_i) are the only liability.

The balance sheet constraint requires that the stock of total assets must equal the stock of total liabilities at each point in time for bank i :

$$(1) \quad R_i + L_i = D_i$$

⁵Many recent studies have examined the determinants of banks’ securitization decisions, as well as efficiency implications of this activity, without linking the process to policy. See, for example [22,23].

Total Reserves (R_i) are held as cash (C_i) or as a net position on the inter-bank market (M_i).

$$(2) R_i = C_i + M_i$$

The interest rate on the inter-bank market, r , the Federal Funds rate, is exogenous to the bank. It is also assumed that banks hold only the minimum required reserves as cash:

$$(3) C_i = \alpha D_i$$

Where the minimum reserve requirement ratio, α , is set by central bank policy and is exogenous to the bank.

To introduce loans sales, assume that there is a fraction, λ_i of loans that are sold to provide liquidity. The parameter λ_i will vary depending on how active bank i is in the secondary market for loans and securitized assets, where λ_i is exogenous for simplicity. Exogeneity is not an unreasonable assumption as Demsetz [15] showed there are participation barriers to entry in the secondary loans market. The purpose of this paper is not to examine *why* banks do or do not participate in the secondary loan market, but rather *given* participation, how the lending response of banks differs. While this parameter will fluctuate over the financial cycle for a given bank, the disparity in participation across banks is assumed constant.

The bank loses a fixed percentage ($1-c$) of sold loans to liquidation costs, such that the total revenue to the bank from loan sales is $c\lambda_i L_i$ where c is exogenous and $0 < c < 1$.⁶

A bank will have a positive position on the inter-bank market when it is a net lender of funds for the period, and this will occur when "on balance sheet" loans $(1-\lambda_i)L_i$ are less than excess reserves.

$$(4) M_i = (1 - \alpha)D_i - (1 - \lambda_i)L_i + c\lambda_i L_i$$

The inverse deposit supply function is assumed to be convex and continuously differentiable. The market deposit interest rate is a function of total industry deposits D , where in the duopoly case $D = D_1 + D_2$.

$$(5) r_D(D) \text{ such that } r_D'(D) > 0$$

The inverse loan demand function facing the bank is such that the market loan rate is a function of total industry loans L , where $L = L_1 + L_2$.

$$(6) r_L(L) \text{ such that } r_L'(L) < 0 \text{ and } r_L'' < 0$$

Bank i faces a cost function for the production of loans and deposits, which is assumed to be separable and increasing in both loan and deposit output. In addition, I assume that the function is non-linear and continuously differentiable such that

⁶The parameter c represents "iceberg" costs and does not include other benefits such as loan diversification.

$$(7) \quad \frac{\partial TC_i}{\partial L_i} = TC'_{L,i} > 0, \text{ and } \frac{\partial^2 TC_i}{\partial L_i^2} = TC''_{L,i} = \gamma_i > 0$$

γ_i represents the slope of the marginal cost curve of loan production for bank 1. As γ_i increases, the elasticity of loan supply increases and bank 1 is less efficient. Technically γ_i is a function of λ_i , however [24] showed that a more efficient bank with a lower *gamma* has a larger negative loan response to rise in interest rates. In this study, the goal is to examine, for a given cost, how banks engaging in loan sales would respond to a change in monetary policy. The bank's decision problem is to maximize profits:

$$(8) \quad \max \pi_i(L_i, D_i) = r_L(1 - \lambda_i)L_i + rM_i - r_D D_i - TC_i(L_i, D_i)$$

Substituting (4) for M_i in (8) yields:

$$(9) \quad \max \pi_i(L_i, D_i) = (r_L - r)(1 - \lambda_i)L_i + rc\lambda_i L_i + (r(1 - \alpha) - r_D)D_i - TC_i(L_i, D_i)$$

The first order condition with respect to loans is:

$$(10) \quad \frac{\partial \pi_i}{\partial L_i} = (1 - \lambda_i)(r_L + r'_L L_i) - r(1 - \lambda_i) + rc\lambda_i - TC'_{L_i} = 0$$

Differentiating (10) with respect to r for banks 1 and 2:

$$(11) \quad [(1 - \lambda_1)(r''_L L_1 + 2r'_L) - \gamma_1] \frac{\partial L_1}{\partial r} + [(1 - \lambda_1)(r''_L L_1 + r'_L)] \frac{\partial L_2}{\partial r} + (1 + c)\lambda_1 = 1$$

$$(12) \quad [(1 - \lambda_2)(r''_L L_2 + 2r'_L) - \gamma_2] \frac{\partial L_2}{\partial r} + [(1 - \lambda_2)(r''_L L_2 + r'_L)] \frac{\partial L_1}{\partial r} + (1 + c)\lambda_2 = 1$$

Where (11) is the reaction function for bank 1, and (12) is the reaction function for bank 2.

For simplicity, but without loss of generalization, set $\lambda_2 = 0$, meaning that bank 2 does not engage in loan sales, but bank 1 may ($0 < \lambda_1 < 1$) engage in loan sales. Solving (12) for $\frac{\partial L_2}{\partial r}$,

substituting this solution into (11), and solving for $\frac{\partial L_1}{\partial r}$ gives the policy response for bank 1 as a function of λ_1 :

$$(13) \quad \frac{\partial L_1}{\partial r} = \frac{(1 - (1 + c)\lambda_1)[r''_L L_2 + 2r'_L - \gamma_2] - (1 - \lambda_1)(r''_L L_1 + r'_L)}{(1 - \lambda_1)[3r''_L L_2 + r'_L r''_L (L^*) - 2r'_L \gamma_2 - r''_L L_1 \gamma_2 - (2r'_L + r''_L L_2 - \gamma_2)\gamma_1]} < 0$$

Equation (13) is negative if $\lambda_1 < 1/(1+c)$. In Fig. 1 we show that on average λ_1 is at most 3% and so even in the extreme case that there are no liquidation costs resulting in a $c=1$, λ_1 would have to be less than 1/2. In addition, if we assume a linear loan demand function so that $r''_L=0$, $\lambda_1 < 1/3$ for equation (13) to be negative. Equation (13) tells us that an increase in

the Federal Funds rate results in a decline in the quantity of loans. The effect of a change in the proportion of loans sold by bank 1 (λ_1) on bank 1's policy response is given by:

$$(14) \quad \frac{\partial}{\partial \lambda_1} \frac{\partial L_1}{\partial r} = \frac{[-(1-\lambda_1)(1+c) - (1-(1+c)\lambda_1)]^* (r_L'' L_2 + 2r_L' - \gamma_2)}{[(1-\lambda_1)(3r_L'^2 + r_L' r_L'' - 2r_L' \gamma_2 - r_L'' L_1 \gamma_2 - (2r_L' + r_L'' L_2 - \gamma_2) \gamma_1)]}$$

The sign of this term depends on the value of λ_1 relative to c^7 , such that for banks with a small exposure to loan sales, this term will be positive. This indicates that, for these banks, having access to the secondary loan market will *reduce* the response of lending to policy shocks (making the policy response derivative $\frac{\partial L_1}{\partial r}$ less negative). This result is consistent with the notion of banks using loan sales as a buffer against liquidity shocks.

As the value of λ_1 increases beyond a tipping point, the second derivative of policy response turns negative. Banks with a large exposure to loan sales will actually experience an *increased* drop in loans on the balance sheet in response to a monetary contraction. In addition, bank level optimal policy response grows as λ_1 increases.

This model, while a simple representation of bank behavior, provides an intuitive testable hypothesis: as loan sale activity increases across banks and over time, the magnitude of lending reduction in response to rising Federal Funds rate will increase, all else constant. Now I turn to specifying a model to test this prediction in US banks.

2.2 Empirical Methodology and Results

2.2.1 Descriptive statistics and data definitions

Bank balance sheet data are taken from quarterly consolidated bank Call Reports available from the Federal Reserve. Banks are divided by real total asset size, since it has already been established that larger banks have a smaller loan response to monetary policy shocks [7,10]. The following categories are used here: small banks with total assets below \$100 million; lower-medium sized banks with total assets between the \$100 million-\$300 million; upper-medium sized banks with total assets between the \$300 million-\$500 million; and large banks with total assets greater than \$500 million. Loans are transferred to a "held-for-sale" account, when the bank intends to sell, securitize or syndicate a loan. Loans held for sale are recorded at the market value as of the balance sheet date.

Tables 1A and 1B below present the descriptive statistics by bank size and participation in loan sales pertaining to this analysis. The descriptive statistics are a snap shot of the banking industry for the beginning and end of the regression sample, 1994:Q1 and 2008:Q4, to glean a quick understanding of how the industry has changed over time. S=1 refers to banks with non-zero values for "loans held for sale". Table 1A presents the bank data from 1994:Q1 and Table 1B presents the same summary statistics for the fourth quarter of 2008.

⁷Second derivative will be negative when $\lambda_1 > \frac{1+5c}{1+c}$.

Table 1A. Descriptive Statistics 1994Q4, S=0 and S=1 for non-selling and selling banks, respectively

Size Category (real assets)	Obs		Equity/Assets		Nonintinc/Op. Inc		Loans/Assets		Securities/Assets	
	S=0	S=1	S=0	S=1	S=0	S=1	S=0	S=1	S=0	S=1
All Sizes	9579	1690	0.099	0.086	0.102	0.143	0.529	0.604	0.335	0.278
<=\$100m	8165	811	0.101	0.089	0.098	0.134	0.524	0.593	0.343	0.283
\$100m-300m	1104	479	0.091	0.086	0.114	0.129	0.558	0.611	0.315	0.287
\$300m-500m	193	111	0.091	0.082	0.131	0.146	0.557	0.627	0.275	0.276
\$500m plus	322	289	0.087	0.079	0.170	0.191	0.538	0.612	0.240	0.252

Table 1B. Descriptive Statistics 2008Q4, S=0 and S=1 for non-selling and selling banks, respectively

Size Category (real assets)	Obs		Equity/Assets		Nonintinc/Op. inc.		Loans/Assets		Securities/Assets	
	S=0	S=1	S=0	S=1	S=0	S=1	S=0	S=1	S=0	S=1
All Sizes	5871	1621	0.117	0.098	0.097	0.135	0.654	0.724	0.204	0.172
<=\$100m	4237	506	0.123	0.102	0.092	0.126	0.642	0.719	0.214	0.164
\$100m-300m	1205	578	0.100	0.096	0.097	0.121	0.708	0.728	0.196	0.171
\$300m-500m	206	202	0.106	0.093	0.104	0.132	0.681	0.744	0.194	0.172
\$500m plus	223	335	0.112	0.098	0.156	0.161	0.579	0.714	0.144	0.167

Several patterns emerge from the data for 1994 and 2008. First, with the exception of the largest banks in the \$500 million plus asset category, selling banks ($S = 1$) hold fewer securities compared to non-selling banks ($S = 0$) in all size categories. This observation is expected (and consistent with [20]) since if selling banks require liquidity, they can simply sell loans to acquire funds. Non-selling banks, unable to sell loans, will have to sell securities instead to gain liquidity. Second, the loan to asset ratio is generally higher for selling banks compared to non-selling banks. Again, selling banks can hold more loans on the balance sheet when those loans are liquid in the secondary loan sales market. Third, the equity to asset ratio is lower for selling banks compared to non-selling banks. Fourth, non-interest income as a fraction of operating income is higher for selling banks compared to non-selling banks. In general, smaller banks tend to hold more equity as a fraction of total assets compared to large banks. In addition, non-selling small banks have a higher securities-to-assets ratio compared to larger banks. Again, the descriptive statistics are consistent with [10] in that small banks hold more liquidity on their balance sheet compared to large banks, however, this is especially true for non-selling banks.

3. RESULTS AND DISCUSSION

3.1 Response of Loan Sales to Policy

For a given bank size, this study tests whether loan response to a change in the Federal Funds rate decreases as loan sales increase. Following [25] and others, the Federal Funds rate (*FFR*) is used as an indicator of monetary policy innovations. The data spans from the first quarter in 1991 to the first quarter in 2007 to account for bank-specific differences that persist throughout the sample. Observations beyond 2007Q1 are omitted to avoid the confounding effects of the financial crisis. The study only includes banks that appear in the

sample for at least 50 consecutive quarters in order to limit the examination to banks that are in existence through at least one complete business cycle. This also mitigates the effect of mergers and acquisitions among banks.

To examine the relationship between loan sales and the Federal Funds rate (*FFR*), Regression 1 below is estimated, with *loans held for sale (HELD)* as the dependent variable. A pooled OLS estimation in first differences is utilized, which eliminates bank specific time-invariant heterogeneity, and any inconsistency that may result. First differences also ensure each series is covariance stationary. The lag structure corresponds to optimization of Schwarz Information Criterion.

$$\text{Regression 1: } \Delta HELD_{it} = b_0 + \rho \Delta HELD_{i,t-1} + b_1 \Delta FFR_t + b_2 \Delta FFR_{t-1} + \sum_{i=0}^2 \Delta \lambda_i Unemp_{t-i} + b_3 \Delta \ln(Assets)_{i,t-1} + b_4 \Delta HouseCPI_{it} + b_5 \Delta Sec_{i,t-1} + b_6 \Delta \ln(Equity)_{i,t-1} + b_7 \Delta \ln(SaveDep)_{i,t-1} + \sum_{j=1}^4 d_j \Delta \ln(loans)_{i,t-j} + f_1 \ln M2 + \text{seasonal dummies} + \text{crisis dummy} + (\text{state indicator} \# \text{CPIhousing}) + e_{it}$$

A contemporaneous and lagged differenced Federal Funds rate (ΔFFR) is included to capture the dynamic nature of monetary policy, and unemployment and regional housing prices (*Housing CPI* and *Housing CPI* interacted with a bank's state code) to partial-out demand-side effects.⁸ Bank specific cluster robust standard errors are reported, correcting test statistics for correlation among error terms over time for each bank. Below in Tables 2A and 2B are the results for Regression 1. For simplicity, only the variables of interest, the coefficients on the contemporaneous and lagged Federal Funds rate, are reported.

Table 2A. Dynamic panel first difference OLS estimates for regression Equation 1, dependent variable is “loans held for sale”

Size	“Small”	“Lower medium”	“Upper medium”	“Large”
Real Assets	\$0-100m	\$100m-300m	\$300m-500m	\$500m+
ΔFFR_t	-50.89*** (P=.000)	-791.17*** (P=.000)	-2005.19*** (P=.000)	-76,340.88*** (P=.003)
ΔFFR_{t-1}	43.63*** (P=.000)	295.27*** (P=.000)	896.71** (P=.04)	55,165 (P=.16)
$\sum_{i=0}^4 \Delta FFR_{t-i}$	-31.384*** (P=.000)	-699.03*** (P=.000)	-1367.73*** (P=.004)	-55,268.31** (P=.03)
(F-stat p-value)				
Mean Loans Held	1,730.7	4,348.24	7,837.97	373,068.2
Growth Rate Effect	-0.018	-0.161	-0.175	-0.148
N	273,418	58,688	9,200	15,708
No. Banks	6,466	2,315	708	683
R ²	0.022	0.101	0.068	0.055

***, **, * refers to statistical significance at the 1%, 5% and 10% levels.

Size categories based on real total assets. Mean Loans held for sale is for “selling banks” in \$000’s. Growth rate effect is calculated as the sum of coefficients on ΔFFR_t terms divided by mean.

⁸The Housing CPI is available from Federal Reserve Economic Database (FRED).

Table 2B shows results from an instrumental variable estimation of the dynamic first difference panel in the Regression 1 equation above. In order to avoid potential endogeneity bias due to correlation between the lagged dependent variable and the error, the autoregressive term is instrumented by its second lag (Anderson and Hsiao [26]). The Hansen and Sargan over-identification test shows that the second lag is, in fact, exogenous. In addition, White robust standard errors are used in each regression to account for heteroskedasticity.

Table 2B. Dynamic panel IV estimates for regression Equation 1, dependent variable is “loans held for sale”

Size	“Small”	“Lower medium”	“Upper medium”	“Large”
Real Assets	\$0-100m	\$100m-300m	\$300m-500m	\$500m+
ΔFFR_t	-39.61*** (P=.008)	-478.11** (P=.03)	-1585.03*** (P=.009)	-71,324.68*** (P=.001)
ΔFFR_{t-1}	54.92*** (P=.000)	665.33*** (P=.000)	2129.41** (P=.03)	69,857.39* (P=.08)
$\sum_{i=0}^{t-4} \Delta F_{FRt-i}$	-16.50** (P=.02)	-468.74*** (P=.003)	-994.81** (P=.04)	-36,702.14* (P=.07)
(F-stat p-value)				
N	273,418	58,688	9,200	15,708
F-stat	7.13	6.70	3.18	2.86
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Root MSE	741.97	5633.5	9899.8	5.8e+05

Note: factor interaction terms between state code and housing prices are omitted from the IV model. Specification is otherwise identical to that in table 2A and shown in Regression 1 equation.

***, **, * refers to statistical significance at the 1%, 5% and 10% levels

Further robustness of results is achieved by accounting for the censored nature of the dependent variable, the change in loans held for sale, which takes on a value of zero in 83% of observations across all size categories. This scenario has been shown to lead to meaningful inconsistency in OLS coefficient estimates in some instances (see Tobin [27] etc.). Table 2C below shows MLE Tobit coefficients for the Regression Equation (1) specification.

The primary result is consistent and robust to specification: the coefficient on the contemporaneous ΔFFR is negative and significant and the coefficient on the lagged ΔFFR is positive and significant for each bank size category, including the largest banks. The coefficients increase in absolute value the larger the bank, indicating a larger dollar value response to a given policy shock. An interpretation is that following a monetary contraction (increase in ΔFFR), loans held for sale *initially fall* as banks reduce their inventory of loan sales for liquidity to buffer the policy induced decline in reserves. The following quarter, loans held for sale begin to rise as banks rebuild their loan sales inventory.⁹

⁹A positive change in loans held for sale indicate that banks are more than replacing their account loans "held for sale". A negative change loans held indicates that banks are not replacing loans sold with new loans "held for sale". It cannot ascertained whether or not a "no change" in loans held is due to loans being sold and replaced one-for-one or due to inactivity banks in that account.

Table 2C. Tobit estimation of regression Equation (1), dependent variable is “loans held for sale”

Size	“Small”	“Lower medium”	“Upper medium”	“Large”
Real Assets	\$0-100m	\$100m-300m	\$300m-500m	\$500m+
ΔFFR_t	-735.08*** (P=.000)	-3551.14*** (P=.000)	-6885.4*** (P=.000)	-411,195*** (P=.000)
ΔFFR_{t-1}	431.25*** (P=.000)	2704.28*** (P=.000)	5148.8*** (P=.000)	361,035*** (P=.000)
$\sum_{i=0}^4 \Delta F_{FR,t-i}$	-347.69*** (P=.000)	-1937.51*** (P=.000)	-3173.63*** (P=.009)	-123,854.8** (P=.016)
(F-stat p-value)				
N	273,418	58,688	9,200	15,708
% obs. censored	91.3%	69.0%	54.4%	49.1%
Pseudo R-sq.	0.0135	0.0124	0.0092	0.0057

Note: P-values calculated using cluster robust standard errors.

***, **, * refers to statistical significance at the 1%, 5% and 10% levels

The five-quarter long-run dynamic multiplier, calculated as the sum of the coefficients on the contemporary and four lags of ΔFFR , is negative and significant in each case. A sense of the magnitude implied is seen in the long run “growth rate effect” calculated in Table 2A. This indicates that the cumulative impact of a 100 basis point increase in the Federal Funds rate over 5 quarters would be a reduction in the growth of loans held for sale between 1.8% and 17%, based on size, for banks that are engaged in loan sales. Thus, the net effect of a monetary contraction is an aggregate reduction in loan sale activity across banks. The results thus far are consistent with the idea that banks use loan sales as a liquidity buffer against monetary contractions.

Clearly, the magnitudes of the coefficients and long-run multiplier, and thus implied growth rate effects, are sensitive to specification, however, the signs and significance are consistent. The largest change comes in the Tobit specification, with magnitudes of the long run multiplier estimates increasing for all size categories. This likely reflects censoring bias in the dynamic panel and IV models.

3.2 The Role of Loan Sales in Total Lending Policy Response

Recall, to test the theoretical model that banks selling loans ($\lambda_1 > 0$) have a *larger* response in loans to a change in monetary policy (ΔFFR), the estimated coefficients should have a negative second derivative with respect to λ_1 : $\frac{\partial}{\partial \lambda_1} \frac{\partial L_1}{\partial \Delta FFR} < 0$. The first derivative states

that as the ΔFFR rises, loans fall. The interpretation of the second derivative is that banks engaging more in loan sales should have a more negative first derivative, i.e. a larger drop in loans following a monetary contraction as banks sell loans to gain liquidity. An interaction term, $\Delta HELD \cdot \Delta FFR$, is used to capture the prediction from equation (14). In order to capture the long-run dynamic nature of the policy response, four lags of the change in FFR are used, as well as two lags of the interaction term. Three quarterly dummy variables, contemporaneous and multiple lags in unemployment and housing inflation, multiple lags of the log difference in $M2$ and savings deposits to control for demand side effects and the business cycle, and multiple lags of the dependent variable total loans to control for the

autoregressive nature of loans are also included¹⁰. To capture regional business cycle effects the bank's state code is interacted with unemployment, housing inflation and M2.¹¹ Also included as independent variables are the lagged log-difference in total assets, equity, and securities to control for bank size within the size groups.

$$\begin{aligned}
 \text{Regression 2: } \Delta \ln(\text{Total loans}_{it}) &= a + \sum_{j=0}^4 b_j \Delta \text{FFR}_{t-j} + \sum_{j=1}^4 c_j \Delta \text{HELD}_{i,t-j} + \sum_{j=1}^2 d_{ij} \Delta \text{HELD}_{i,t-j} * \Delta \text{FFR}_{t-j} \\
 &+ \sum_{j=1}^4 e_{ij} \Delta \ln(\text{totalloans}_{i,t-j}) + \sum_{j=1}^4 f_{ij} \Delta \ln(\text{Equity})_{i,t-j} + \sum_{j=1}^4 g_{ij} \Delta \text{Sec}_{i,t-j} + \sum_{j=1}^2 h_{ij} \ln(\text{Assets})_{i,t-j} \\
 &+ \sum_{j=1}^2 l_j \Delta \ln(\text{SavDep})_{i,t-j} + \sum_{j=1}^2 n_j \Delta \text{House}\pi_{t-j} + x_t \pi_t + \sum_{j=0}^4 p_j \Delta \text{unemp}_{t-j} + \sum_{j=0}^2 q_j \Delta \ln(\text{M2})_{t-j} + \\
 &+ \sum_{j=1}^3 r_j \text{dum}_j + \sum_{k=1}^{49} s_k \text{statecode}_i * \Delta \text{House}\pi_{t-1} + \sum_{k=1}^{49} u_k \text{statecode}_i * \Delta \ln \text{M2}_{t-1} \\
 &+ \sum_{k=1}^{49} v_k \text{statecode}_i * \Delta \ln \text{M2}_{t-2} + \sum_{k=1}^{49} w_k \text{statecode}_i * \text{unemp}_t + e_{it} \quad \text{where}
 \end{aligned}$$

$t = \text{time}$
 $i = \text{bank}$
 $j = \text{lag}$
 $k = \text{state}$

Again, since pooled OLS in first differences is used, the fixed effects are not estimated. Of particular interest is the interaction between loans held for sale and the policy variable, $\Delta \text{HELD} * \Delta \text{FFR}$. As mentioned above, it should be negative and significant, especially for banks that sell loans following an increase in the Federal Funds rate. The OLS coefficient estimates for the variables of interest are reported in Table 3A below.

¹⁰ M2 includes savings deposits at the aggregate level. No one bank however will have an influence on M2 nor will savings deposits at the bank level influence M2 at the aggregate level. Therefore, M2 is exogenous to any individual bank. Housing inflation is the difference in FRED's housing CPI data.

¹¹ The banks' State code is included to capture geographic differences in lending.

Table 3A. Estimates for first-difference regression Equation 2: Dependent variable is log total net lending (1990q1-2007q1)

Size categories	“Small”	“Lower medium”	“Upper medium”	“Large”
Total Real Assets $\sum_{i=0}^4 \Delta F_{FR,t-i}$	\$0-\$100m -.006*** (P=.000)	\$100-\$300m -.006*** (P=.01)	\$300m-\$500m -.008 (P=.29)	\$500m+ -.010 (P=.15)
(F-stat p-value) $\sum_{i=0}^1 \Delta H_{ELD,t-1-i} \Delta_{FFR,t-i}$	-1.71e-07 (P=.93)	-7.73e-07* (P=.05)	-1.73e-06*** (P=.000)	-2.91e-09 (P=.46)
(F-stat p-value) Total Policy Effect for Selling Banks at 1S.D. above mean $\sum_{i=0}^4 \Delta H_{ELD,t-i}$	-	-.0111	-.0259	-
(F-stat p-value) N No. Banks R ²	221,973 5,340 0.104	44,860 1,821 0.042	8,152 550 0.078	11,656 518 0.025

***, **, * refers to statistical significance at the 1%, 5% and 10% levels, White HCCM robust standard errors.

Table 3B below addresses potential endogeneity bias in the panel autoregressive term by using the second lag of differenced total loans as the external instrument for the first lag, with lags two through four omitted. Otherwise, the specification is identical to that found in Equation (2).

Table 3B. IV Estimates for dynamic panel first-difference regression equation 2: dependent variable is log total net lending (1990q1-2007q1)

Size categories	“Small”	“Lower medium”	“Upper medium”	“Large”
Total Real Assets $\sum_{i=0}^4 \Delta F_{FR,t-i}$	\$0-\$100m -.019*** (P=.000)	\$100-\$300m -.005** (P=.04)	\$300m-\$500m -.021*** (P=.007)	\$500m+ -.031 (P=.90)
(F-stat p-value) $\sum_{i=0}^1 \Delta F_{ELD,t-1-i} \Delta_{FFR,t-i}$	6.16e-06 (P=.13)	-1.12e-06 (P=.13)	-1.28e-06*** (P=.000)	4.57e-09 (P=.96)
(F-stat p-value) $\sum_{i=0}^4 \Delta F_{ELD,t-i}$	-.00002*** (P=.004)	-1.83e-06*** (P=.01)	-1.86e-06* (P=.06)	-2.91e-08 (P=.89)
(F-stat p-value) N No. Banks Root MSE	221,973 5,340 0.17	44,860 1,821 0.08	8,152 550 0.12	11,656 518 0.43

***, **, * refers to statistical significance at the 1%, 5% and 10% levels, White HCCM robust standard errors.

As Tables 3A and 3B show, the sum of the impacts of lagged, differenced Federal Funds rate ($\Sigma\Delta FFR$) is negative in all size groups. However, negative and significant coefficients are observed for small and medium sized banks only. This is consistent with previous studies [1,10] which find that an increase in the Federal Funds rate is associated with a decline in loans for smaller banks only.

The sum of the coefficients on the interaction term, which includes the policy response for banks that sell loans, ($\Sigma\Delta HELD*\Delta FFR$) is negative and significant for only the two medium size categories. For the lower-medium sized banks, the interaction coefficient sum is negative and significant at the 10% level. For the upper-medium sized banks, the coefficient sum is larger in absolute value, negative and significant at the 1% level. These results suggest that medium sized banks which engage in loan sales will experience a larger reduction in total loans following a monetary contraction, compared to an identical bank that does not engage in loan sales. Likewise, the larger the magnitude of loan sale activity, the larger the change in policy response. Note that the cumulative interaction effect is given for only two quarters, as the significance of the impact dissipates beyond that point. This negative cumulative coefficient on the second derivative interaction term is consistent with the prediction of the simple balance sheet model.

To appreciate the magnitude of the estimated effect of loan sales on total lending response, it is noted that the sample quarterly mean of $\Delta HELD$ for the selling banks within the \$300M-\$500M size category is \$494,000, with a standard deviation of \$9,891,000. Thus, a bank heavily engaged in loan sales at one standard deviation above the mean, the change in response to a 100 basis point increase in the Federal Funds Rate over a six month period will be $(\$10,385,000)*(-1.73e-06) = -.0179$. Adding this to the estimated long run propensity for ΔFFR gives the total effect of $-.0259$, or a 2.5% reduction in loan growth. Comparing this response to that for non-selling banks ($\Delta HELD=0$) of 0.0079, there is over a threefold increase in sensitivity. The same calculation for the \$100M-\$300M category shows response nearly doubles for heavily selling banks. The results are not reported for size categories where the estimated interaction terms are not found to be significant. These results indicate that the impact of monetary contraction on lending will be meaningfully larger for banks engaged in loan sales.

It is also observed from Table 3 that for banks under \$300M in real assets, there is a negative and significant cumulative impact of loan sales on total loans held on the balance sheet. Banks which reserve a greater value of loans for future sale have a smaller value of loans on their balance sheet at a given point in time, indicating a smaller loan portfolio. While this finding appears counter to that of [20], this discrepancy is very likely due to the different nature of loan sale indicator used (potential securitization, as opposed to actual loan sale accounts used here). A bank with greater securitization potential will, by definition, own a larger value of liquid and salable loans.

A possible reason why a significant policy response differential is not observed for large banks, even though they participate heavily in the loan sales market, is that large banks have greater access to financial markets as informational asymmetries and agency costs are lower. Instead of selling loans to buffer their balance sheet from a monetary shock, large banks can simply raise alternate sources of funds compared to medium sized banks in response to contractionary monetary policy. Further, large banks tend to focus on different types of loans (e.g. commercial and industrial) compared to smaller banks (e.g. mortgages and personal loans) which would respond differently to a monetary contraction.

4. CONCLUSION

This study provides some new insight into bank behavior following a monetary policy shock. The results suggest that although banks can theoretically use loan sales to buffer their balance sheets against monetary policy shocks, not all banks do so. Evidence indicates that medium sized banks sell loans in response to a monetary contraction, and results suggest that banks use loan sales to buffer their balance sheets against monetary policy shocks by providing liquidity. This has important implications for policy makers since many firms and individuals are bank dependent and access to credit during a monetary contraction is paramount to economic activity. If banks respond heterogeneously to monetary contractions, one would also expect to see a heterogeneous response from bank dependent customers. When medium sized banks are unable to sell loans to shore-up reserves resulting from a monetary shock or to shore-up capital following a financial market shock, these banks may be forced to restrict credit; one of many possible contributing factors of the 2008-09 credit crunch.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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