FEDERAL RESERVE BANK OF SAN FRANCISCO

WORKING PAPER SERIES

The Bank Lending Channel Is Back

Mark M. Spiegel
Federal Reserve Bank of San Francisco

February 2025

Working Paper 2025-04

https://doi.org/10.24148/wp2025-04

Suggested citation:

Mark M. Spiegel. 2025. "The Bank Lending Channel Is Back." Federal Reserve Bank of San Francisco Working Paper 2025-04. https://doi.org/10.24148/wp2025-04

THE BANK LENDING CHANNEL IS BACK

MARK M. SPIEGEL

Abstract. The period following the global financial crisis was marked by low interest rates and low responsiveness of bank lending to monetary policy. This led some to conclude that the bank lending channel for monetary policy to influence economic activity had weakened. This paper revisits the responsiveness of the bank lending channel using a bank-level panel of US Call Report data and updated measures of U.S. monetary policy shocks. Results indicate that the efficacy of the bank lending channel increased over our sample period. We find tepid responses in bank lending to monetary shocks from 2012H1 through 2016H2, matching the existing literature, but significantly more robust responsiveness after liftoff, represented by the latter portion of our sample from 2017H1 through 2023H2. Separating the later panel by bank size reveals that the bank lending channel is larger for small and medium-sized banks than for large banks over this later period, also consistent with studies predating the global financial crisis. Increases in responsiveness at conventional rates are even greater for small business lending. An interactive specification over our entire sample period confirms that the stronger recent bank lending responses to monetary policy shocks are associated with sufficiently high prevailing levels of the federal funds rate.

Date: February 11, 2025.

Key words and phrases. credit channel, interest rate channel, monetary policy.

JEL classification: E58, E63, G14, G18, G32

Spiegel: Federal Reserve Bank of San Francisco (Mark.Spiegel@sf.frb.org). Helpful comments were received from Michael Bauer, Jens Christensen and Vasco Curdia. Lora Dufresne provided excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

I. Introduction

Over the early portion of the period following the global financial crisis U.S. core PCE inflation was consistently below the Federal Reserve's 2% target, despite the low policy rates prevailing during that period. This led some to speculate that the efficacy of transmission channels for reductions in interest rates to induce heightened bank lending activity and thereby bring inflation back to target levels, commonly referred to as the bank lending channel, had weakened (e.g. Borio and Hofmann (2017), Abadi et al. (2023) and Ulate (2021)).

One reason that banks may not be as responsive to monetary policy shocks in low interest rate environments is that these environments are generally seen as challenging for banks due to low profitability (Borio and Hofmann (2017)). Banks are generally loathe to reduce rates to very low or particularly negative values, due to concerns that doing so would erode their deposit base. As a result, net interest margins can become squeezed in the neighborhood of the zero lower bound (e.g. Altavilla et al. (2018) and Eggertson et al. (2024)).

Alternatively, easy monetary conditions likely reflect weak economic conditions, which inhibit lending profitability (Borio and Hofmann (2017)), and often coincide with periods where raising capital is challenging (e.g. Diamond and Rajan (2011)).

In this paper, we make use of the higher monetary policy rates that have prevailed more recently to revisit the efficacy of the bank lending channel for monetary policy. Since the liftoff of federal funds rate from zero in 2015, interest rates have been higher on average and have displayed a lot of variability, particularly during the COVID-19 pandemic, where interest rates were lowered briefly to zero and then increased rapidly when inflation rates became elevated.

We examine the implications of monetary policy shocks, measured using an updated version of the Bauer and Swanson (2023) measures of monetary policy shocks around FOMC meeting announcements.[1]

Our frequency is biannual to ensure full bank coverage. We aggregate the reported monetary policy shocks during each observation period to obtain a proxy for cumulative shocks during that period. The Bauer-Swanson measures identify policy changes at sufficiently high frequencies that changes are solely driven by the policy surprise.

[1] In addition to FOMC announcements, Bauer and Swanson (2023) includes shocks from press conferences, speeches and testimony by the Federal Reserve Chair. However, this series only extends to 2019H2. Our sample period, which is based solely on FOMC announcement events, extends to 2023H2.

Of course, other macroeconomic changes are likely to be taking place over our half-year observation periods that may independently influence bank lending growth, so we also include macroeconomic indicators in our base specification to capture those as well as possible. Our base specification also uses the Bauer and Swanson (2023) "orthogonalized" series, which removes the portion of monetary policy movements that are predictable based on macroeconomic conditions.[2]

We sample bank-level Call Report data, which allows us to condition on individual bank characteristics. These include proxies for funding strategies, leverage, problem loans, and liquidity. We also allow for disparities by bank size. Previous studies (e.g. Kashyap and Stein (2000)) argue that the strength of monetary policy is likely to vary by bank size, as smaller banks seem to be more responsive to policy changes.[3]

Our sample runs from the beginning of 2012H1 through 2023H2. The start of our sample coincides with essentially full Call Report reporting for all U.S. commercial banks in the second and fourth quarters and avoids selection bias issues associated with bank reporting.

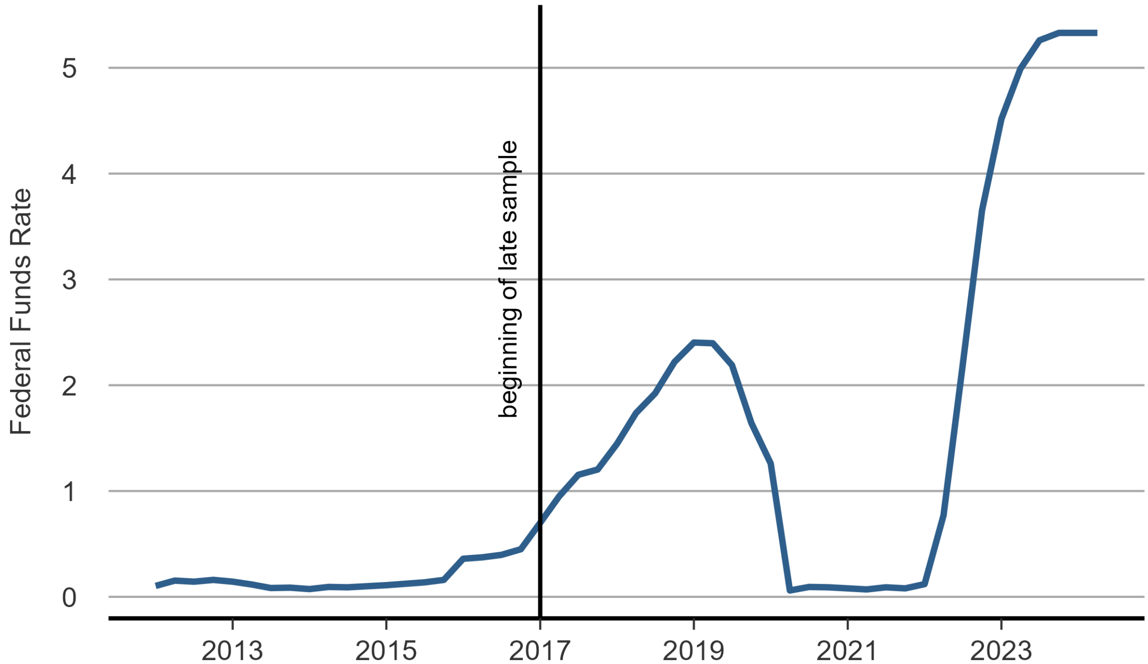
Our full sample period includes a wide variety of levels for the federal funds rate. See Figure 1. Over the early portion of our sample, the funds rate remained near the zero lower bound within its 0-0.25 percent policy range. Policy rates also remained low immediately after liftoff, as the funds rate only increased about 30 basis points further over the course of 2016. However, by the start of 2017, the funds rate was rising rapidly. Having reached a level of 0.54, the funds rate had moved above the 50 basis point level where studies have found that low funds rates were associated with difficulties for banks (e.g. Ulate (2021)). Average rates that prevailed over the latter portion of our sample were substantively higher than those that prevailed previously. We therefore divide our sample roughly in half, with an early period from 2012H1 through 2016H2 and a late period from 2017H1 through 2023H2 to evaluate any disparities in bank responsiveness under low and high average funds rate levels.

Our results suggest a notable shift in the responsiveness of bank lending to monetary policy shocks over the course of our sample: Over the early sample period, average values of the federal funds rate were quite low and we obtain unconventional coefficient estimates for the bank lending response to monetary policy shocks. Our coefficient

[2]The orthogonalized and unorthogonalized Bauer and Swanson (2023) shocks used in this study are shown in Appendix Figure A1.

[3]Kashyap and Stein (2000) argue that this discrepancy is likely to be driven by the fact that small banks are more dependent on conventional deposits for funding, and therefore likely to lose (gain) more core deposits when monetary policy is tightened (eased).

Figure 1. Federal Funds Rate



Note: Federal funds rate from 2012H1 through 2023H2. Vertical line indicates break between early and late samples in 2016H2. Source: FRED.

estimates enter with the incorrect positive sign – usually at statistically significant levels – although with point estimates that are quite low in absolute value relative to those we obtain for the latter portion of our sample.[4] This modest response mirrors the literature suggesting that bank lending responses to monetary shocks were muted in the neighborhood of the zero lower bound.

In contrast, for the latter period we obtain the conventional statistically significant negative lending responses to monetary policy shocks. This response is also much larger in absolute value, as the coefficient point estimate for the latter half of our sample is more than 6 times the size of that obtained for the early sample portion.

[4]As monetary policy was often constrained at the zero lower bound in this period, the Bauer and Swanson (2023) measures of policy shocks likely missed a number of important policy measures that were not covered by their series. As such, the unconventional results obtained for this period are likely to at least in part reflect measurement error in our proxy for monetary policy shocks.

This result is robust to removing the observations from the volatile pandemic period, demonstrating that our results are not driven by that period.[5]

We also separate the sample into small, medium and large bank subgroups based on bank asset holdings. Small banks are most responsive in terms of changes in percentage growth in lending, medium-sized banks are second, and large banks are the least sensitive. This is also in keeping with earlier literature, such as Kashyap and Stein (2000), who found the bank lending responses to monetary policy shocks were more robust for smaller banks, and provides additional evidence that patterns in lending responses to monetary policy shocks have reverted back to patterns which prevailed prior to the global financial crisis.

We then explicitly whether the differences found in bank lending sensitivity over the course of our sample to monetary policy shocks are associated with the level of prevailing policy rates. Beginning in 2012, we interact the monetary policy shock variable with an indicator variable that takes value 1 if the level of the federal funds rate is greater than fifty basis points and 0 otherwise. Ulate (2021) finds that below this rate banks start experiencing difficulties in managing their balance sheets and profitability. The cutoff identifies both the early sample period and a portion of the pandemic period as periods in our sample where bank responses to monetary policy may be muted.

Our results are consistent with the theory. We obtain a negative and statistically significant coefficient point estimate on this interactive variable, suggesting that the response of bank lending to monetary policy shocks does follow conventional patterns on average at funds rate levels above 50 basis points.

Finally, we repeat our interactive specification for changes in small business lending. Our Call Report-based bank-level sample is well-placed to consider small business lending responses, as lending patterns of small banks, which play an outsized role in small business lending, are not observable in data sets limited to larger institutions, such as Y-14 data. Our results suggest greater sensitivity of small business lending to monetary policy shocks than overall lending, with higher point estimates for sensitivity to monetary shocks found among medium and large banks. However, the observed differences by bank size are not statistically significant.

[5]Bauer and Swanson (2023) do not release orthogonalized versions of their policy shock estimates for two half-years of the pandemic period, and our base sample is missing those two half years. In response, we also demonstrate in the appendix that our results are robust to using the non-orthogonalized shock data series from Bauer and Swanson (2023) which includes the entire pandemic period (See Table A2).

The paper is divided into 7 sections. The next section reviews the literature on the monetary policy interest rate channel, focusing on recent work on diminished sensitivity of bank lending to monetary policy shocks in the neighborhood of and below the zero lower bound. Section 3 discusses the data and panel estimation used in our study. Section 4 reports our panel results for our base specification for the full and late sub-samples by bank size. Section 5 introduces our full-sample interactive specification and reviews the results. Section 6 repeats the full-sample interactive specification for growth in small business lending. Lastly, section 7 concludes.

II. Literature

In this section, we review the literature on the dependence of the efficacy of the bank lending interest rate channel on interest rate levels. This literature largely focuses on the theory that under very low or negative rates, interest rate reductions from monetary easing may actually have adverse implications for bank profitability, resulting in tepid lending responses.

Borio and Hofmann (2017) identify two channels through which bank profitability may be reduced under low interest rates. First, easy monetary conditions likely reflect weak economic conditions, which inhibit lending profitability and often coincide with periods where raising capital is challenging.[6] Second, net interest margins may display nonlinearities when interest rates are low. As banks are reluctant to drop deposit rates below zero, the gains from lowering rates are diminished in the neighborhood of zero bound, as the gap between lending and deposit rates decreases.

A number of recent studies confirmed that bank profitability is reduced in low interest rate environments. Genay and Podjasek (2014) find that higher short-term interest rates are associated with higher bank profitability for all sizes of banks, but the impact varies systematically by bank size, with larger increases in profitability for small banks than large banks.

Indeed, it is possible that at certain interest rates monetary easing will reduce bank profits. Abadi et al. (2023) term the interest rate at which the declining net interest rate margin effect dominates resulting in accommodative monetary policy reducing lending the "reversal interest rate," and demonstrate in a New Keynesian model that this rate can occur at positive short-term interest rate levels. Ampudia and den Heuvel (2022) find that surprise cuts at or below zero rates in the euro area had a negative impact on European bank equity values. Similarly, Eggertson et al. (2024)

[6] Also see Diamond and Rajan (2011).

find that the pass-through of monetary policy in Sweden is sharply reduced below the zero lower bound.

However, some argue that even movement into negative rates has had only modest implications for bank profitability, due to banks' abilities to turn to other sources of revenue, such as enhanced fees, when interest rates fall below the zero lower bound (Lopez et al. (2020)). In addition, Altavilla et al. (2022) find that European corporate deposits did not fall in the wake of movements by the European Central Bank policy rate into negative territory. Banks also earn positive returns on their securities holdings, which disproportionately benefits banks with relatively high securities holdings, such as large banks. This may partly explain the higher sensitivity of bank profitability to interest rates found among small banks by Genay and Podjasek (2014). Paul (2022) finds that during pre-pandemic monetary tightening bank profitability increased, and lending rates were adjusted more quickly than deposit rates after policy liftoff.

There is considerable empirical evidence of a bank lending channel at conventional rates of interest. For example, Romer and Romer (1990) and Bernanke and Blinder (1992) both find that monetary policy shocks or movements in the federal funds rate are associated with conventional bank lending responses under both policy easing and tightening. Moreover, as discussed by Kashyap and Stein (1994), there is considerable evidence that lending expansions correspond to subsequent increases in activity, although they question the economic importance of the bank lending channel. However, Oliner and Rudebusch (1995) question the evidence supporting the bank lending channel, arguing that that the observed decreased bank lending subsequent to monetary policy tightening actually reflects a reallocation of capital toward large, and therefore less bank dependent, firms from smaller firms.

There are also studies that question the existence of an adverse impact of low interest rates on the efficacy of the lending channel. Morris and Sellon (1995) find no evidence of a relationship between the federal funds target rate and business lending. They conclude that disintermediation due to losses in core deposits is avoided by banks through sales of securities, rather than reductions in lending activity. Burietz and Picault (2023) find that low expansionary conventional monetary policy encouraged increased syndicated lending in Europe during and immediately after the global financial crisis.

Our study is also related to the literature on disparities in the efficacy of the bank lending channel by bank characteristics. Kashyap and Stein (2000) find that the strength of the bank lending channel depends on bank soundness, with banks in weaker financial positions finding themselves financially-constrained and therefore more responsive to monetary policy shocks. Capital positions and balance sheet liquidity have also been shown to influence responsiveness to monetary shocks [e.g. Gambacorta (2005), Jiménez et al. (2012) and Andrade et al. (2019)]. Balance sheet positions may also matter, as disparities may arise in capital gains or losses on securities holdings in the wake of monetary policy shocks may lead banks to adjust their lending activities [e.g. Greenwald et al. (2024)]

Disparities in responsiveness by bank size, examined in this study, have also been documented. Kashyap and Stein (2000) find that lending by small banks are responsive to monetary policy changes, while lending by large banks are not. An explanation may be that when monetary policy is tightened small banks lose core deposits, on which they are more dependent for funding than large banks, and therefore must cut back on lending activities in response. Another source for the relatively weak domestic lending response to monetary shocks by large banks on average may be attributable to their international operations. Cetorelli and Goldberg (2012) show that global banks respond to domestic policy shocks by rebalancing their lending portfolio in favor of foreign lending activity.

More recently, Naqvi and Pungaliya (2023) confirm that small banks are more responsive to changes in the federal funds rate than large banks. Their explanation for this discrepancy is that the too big to fail guarantee enjoyed by large banks leaves large banks less responsive to policy changes. Of relevance for this study, their results also suggest a role for the monetary policy stance to influence the discrepancy in large and small bank lending, with the disparity only arising at sufficiently high rates of interest.

The tepid bank lending response at low or negative policy rates has also been shown to weigh on the welfare benefits of monetary policy as a policy tool. In a recent study, Ulate (2021) demonstrates in a New Keynesian model that monetary policy is only 60 to 90 percent as effective in terms of improved welfare relative to no policy response when rates are low or negative.

Finally, the literature distinguishes between the interest channel, highlighted in the studies above, and the “credit" channel, whereby the lending response to monetary policy may be weakened because potential borrowers are credit constrained. As discussed by Ciccarelli et al. (2015), however, distinguishing the credit channel from the interest rate channel typically requires separating loan supply and demand effects of monetary policy shocks, and is therefore challenging.

III. Data and estimation methodology

III.1. **Data.** Our dataset is an unbalanced panel containing bank-level regulatory filings obtained from the Federal Financial Institutions Examination Council's "Call Reports", which provide detailed information on both balance sheet and income statement variables.[7] Our frequency is biannual, comprised of half years, and are measured as of end of period.[8] The time series of our panel stems from 2012H1 through 2023H2, with the beginning of the panel corresponding to the first year for which complete small bank reporting was available. Starting in 2012 avoids any sample selection bias that may be associated with bank reporting decisions.

Reporting banks are separated into three groups based on asset size in 2019H2. Our designations follow Call Report conventions, with small banks defined as those with assets below $10 billion, large banks with assets exceeding $100 billion, and medium-sized banks between them, based on bank assets in 2019H2.[9] Our base specification full sample contains 7107 banks, of which 6941 are classified as small banks, 134 as medium-size banks, and 32 as large banks.

As discussed above, the funds rate rose rapidly after liftoff in 2015, and had reached 0.54 by the start of 2017. In response, we divide our sample roughly in half, with an early period from 2012H1 through 2016H2 and a late period from 2017H1 through 2023H2, periods of five and six years respectively.[10]

III.2. **Base model specification.** Our variable of interest is $MPSHOCK_t$, the sum of monetary policy shocks reported by Bauer and Swanson (2023) from period $t-1$ through period t. These shocks are obtained from the first principal component of

[7]For banks to be included in our base specification, data must exist for that firm from period $t-1$ through period $t+1$, so that data on bank characteristics and subsequent lending growth are both included.

[8]We limit our analysis to half years as Call Report coverage is incomplete, particularly for smaller banks, during quarters 1 and 3.

[9]For banks that closed or merged, we assess their size and lending levels based on the last period for which we have data.

[10]We choose the beginning of 2017 to start the later sample after the funds rate crossed the 50 basis point threshold identified by Ulate (2021) as associated with bank difficulties. As a robustness check, we also split the samples at earlier dates following liftoff from the zero lower bound, 2015H1 and 2016H1. Our results, which are shown in Appendix Table A1, are qualitatively unchanged.

movements in the first four Eurodollar futures contracts around FOMC announcements, scaled so that a one-unit change corresponds to a one percentage point change in the four quarters ahead "ED4" contract. These changes are then orthogonalized by removing the component of surprises that are correlated with financial conditions and economic activity.

This variable is missing for two half-years during the pandemic period, 2020H2 and 2021H1, as orthogonalization with respect to financial and activity variables proved difficult during the pandemic period. In response, we run a number of diagnostics around the pandemic to make sure that our results are robust to the inclusion of a dummy for our pandemic period, which runs for the two-year period from 2020H1 through 2021H2, and also rerun our specifications using the unorthogonalized alternative monetary shock series from Bauer and Swanson (2023), which are available for the full time series.[11]

Our dependent variable, $\%\Delta LEND_{i,t+1}$, is the percentage growth in lending of bank i in period t through $t+1$.

Bank conditioning variables include $LIQUID_{i,t}$, which measures bank cash and security holdings as a share of total assets, as a measure of bank liquidity; $DEPOSITS_{i,t}$, which measures core deposits relative to total assets to capture a bank's reliance on deposit funding; $TIER1CAP_{i,t}$, a measure of tier one capital relative to total risk-weighted assets, and $PROB_{i,t}$ as an aggregate measure of past-due and non-accrual "problem" loans relative to total assets all at the bank level, to measure bank lending performance. All specifications also include bank fixed effects.

Our bank-level dependent and conditioning variables are winsorized at the 2.5%-97.5% level to reduce the influence of reporting errors and outliers by individual banks.

Because our variable of interest varies only by time, we also include a number of time-varying conditioning variables. These include ΔGDP_t, which measures the percentage change in GDP from period $t-1$ through t, VIX_t, the level of the volatility index at time t, $PROP_t$, a measure of property prices at time t, as well as changes in those variables relative to the previous period,ΔVIX_t and $\Delta PROP_t$[12]

Our base specification sample is a panel of individual bank lending growth at half-yearly frequency from 2012H1 through 2023H2. We examine the full cross section of

[11]These results are shown in Appendix Table A2.

[12]Changes are measured as log differences. For space purposes, we suppress the coefficient estimates on our time conditioning variables, ΔGDP_t, $PROP_t$, VIX_t, $\Delta PROP_t$ and ΔVIX_t. Results for the full specification including coefficient estimates on the time-varying conditioning variables are included in the online appendix.

U.S. commercial banks included in the Call Report. Our base specification dependent variable measures the percent change in total lending by bank i from time t through $t+1$. Given data limitations associated with our conditioning variables, our full sample specification has 123,721 observations for 7,107 banks.

TABLE 1. Summary Statistics

	Full Sample	Early Sample	Late Sample	Pandemic Period
%ΔLEND	0.03	0.03	0.04	0.02
	(0.07)	(0.07)	(0.07)	(0.07)
%ΔSBLEND	0.03	0.02	0.03	-0.03
	(0.13)	(0.12)	(0.14)	(0.13)
MPSHOCK	0.02	-0.00	0.05	0.06
	(0.07)	(0.06)	(0.06)	(0.06)
HIGHFFR	0.41	0.00	0.84	0.51
	(0.49)	(0.00)	(0.36)	(0.50)
LIQUID	0.09	0.10	0.09	0.13
	(0.08)	(0.08)	(0.08)	(0.09)
DEPOSITS	0.84	0.84	0.84	0.84
	(0.06)	(0.06)	(0.06)	(0.06)
TIER1CAP	0.11	0.11	0.11	0.11
	(0.03)	(0.03)	(0.03)	(0.03)
PROB	0.01	0.02	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
ΔGDP	2.17	1.91	2.46	0.51
	(1.72)	(0.52)	(2.38)	(5.18)
VIX	16.99	15.75	18.32	25.99
	(4.71)	(1.95)	(6.19)	(7.04)
PROP	123.65	108.63	139.71	144.70
	(19.53)	(8.22)	(14.75)	(10.40)
ΔVIX	-0.02	-0.08	0.05	0.36
	(0.25)	(0.18)	(0.30)	(0.44)
ΔPROP	0.02	0.03	0.02	0.04
	(0.01)	(0.01)	(0.02)	(0.01)

Standard deviation in parentheses. See text for variable definitions.

Sources: NIC Metadata/FFIEC, Bauer Swanson, FRED

Summary statistics for our base specification sample are shown in Table 1. We also report summary statistics for two variables used below in our interactive specifications: A qualitative variable, $HIGHFFR_t$, which takes value 1 if the average value of the federal funds rate in the previous period was greater than 0.5, and 0 otherwise, and $\%\Delta SBLEND_{i,t}$, which measures the percentage change in small business lending from period t through $t+1$. We follow the Call report convention of designating small business loans as those with principal values exceeding $1 million.

Comparing the early and late sub-samples in columns 2 and 3, the entire early period is below this threshold, while for the late period, the bulk of periods are above the threshold. The exception in the late period occurs during the pandemic, when policy rates were also reduced to 0. The mean and standard deviation values in our dependent variable, $\%\Delta LEND_{i,t+1}$, are roughly the same in the early and late periods, but the mean value of the monetary policy shock increased from -0.00 to 0.05 from the early to late period sub-sample.

Our base specification satisfies:

$$\%\Delta LEND_{i,t+1} = c + \beta_1 MPSHOCK_{t,t-1} + \gamma X_{i,t} + \eta Z_t + \phi_i + \epsilon_{i,t} \tag{1}$$

where β_1 represents our coefficient estimate of interest, $X_{i,t}$ denotes the bank-specific conditioning variables, $LIQUID_{i,t}$, $DEPOSITS_{i,t}$, $TIER1CAP_{i,t}$, and $PROB_{i,t}$; Z_t denotes the time-specific conditioning variables, ΔGDP_t, $PROP_t$, VIX_t, $\Delta PROP_t$ and ΔVIX_t; ϕ_i represents bank fixed effects, and $\epsilon_{i,t}$ is the regression residual.

To deal with potential correlation in standard errors across banks, we cluster our standard errors by bank.

IV. Results

IV.1. **Full sample results.** Our results are shown in Table 2. The first three columns correspond to our full sample period from 2012H1 through 2023H2. The first column reports our base specification. It can be seen that our variable of interest, $MPSHOCK$, enters negatively and significantly, at a 1% confidence level. Based on values from Table 1, our point estimate for this coefficient indicates that a 25 basis point increase in $MPSHOCK$, holding all else equal, would be predicted to result in a 5.3 basis point reduction on average in annualized bank lending growth over the following six months. Our full sample results therefore support the existence of a conventional bank lending channel on average.

For the bank-level conditioning variables, we obtain positive and statistically significant coefficient estimates for $LIQUID$, $DEPOSITS$, and $TIER1CAP$, indicating that holding all else equal banks with higher liquidity positions, greater reliance on deposit funding and greater risk-adjusted capital asset ratios have higher lending growth on average. In contrast, we obtain a statistically significant negative coefficient on $PROB$, indicating that banks with higher shares of problem loans had lower lending growth on average.

Table 2. Base specification results

		Full Sample		Early Sample	Late Sample	
	Base	Pan. dummy	No pan.	Base	Pan. dummy	No pan.
MPSHOCK	-0.1063***	-0.1072***	-0.1080***	0.0371***	-0.2499***	-0.3001***
	(0.0037)	(0.0037)	(0.0037)	(0.0053)	(0.0068)	(0.0086)
LIQUID	0.0589***	0.0705***	0.0821***	0.1516***	0.0342***	0.1103***
	(0.0063)	(0.0064)	(0.0070)	(0.0105)	(0.0082)	(0.0102)
DEPOSITS	0.0902***	0.0831***	0.0854***	0.1499***	0.1335***	0.1108***
	(0.0097)	(0.0096)	(0.0105)	(0.0194)	(0.0127)	(0.0138)
TIER1CAP	0.4840***	0.4761***	0.4934***	0.7159***	0.6965***	0.5898***
	(0.0271)	(0.0272)	(0.0286)	(0.0436)	(0.0375)	(0.0414)
PROB	-1.2234***	-1.2345***	-1.2272***	-1.1449***	-1.0277***	-1.0388***
	(0.0336)	(0.0335)	(0.0337)	(0.0445)	(0.0597)	(0.0646)
Constant	-0.0798***	-0.0965***	-0.1008***	-0.0942***	-0.1678***	-0.1484***
	(0.0088)	(0.0088)	(0.0097)	(0.0196)	(0.0116)	(0.0133)
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y	Y
Observations	123721	123721	114041	63858	59863	50183

Note: OLS estimation with standard errors clustered by bank in parentheses. Cols. 1-3 full sample; col. 4 early sample; cols. 5 and 6 late sample. Dependent variable is $\%\Delta LEND$, percentage growth in bank lending from period t through $t+1$. Variable of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are available in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Columns 2 and 3 modify the specification to investigate the possibility that our results may be driven by the COVID-19 pandemic. Column 2 introduces a dummy variable for the pandemic, which given our half-yearly frequency is specified to run for the two-year period from 2020H1 through 2021H2. Column 3 drops the available pandemic observations from the sample. The results for our variable of interest, $MPSHOCK$ are qualitatively the same for all three specifications, with the variable continuing to enter significantly negative with roughly the same point estimate.

However, as discussed above, we know that the early period of our sample corresponded to one of well-documented weakness in bank lending. In response, we split the sample into an early period, from 2012H1 through 2016H2, and a late period from 2017H1 through 2023H2.

The early sample period sub-sample results are reported in column 4. Our coefficient estimate for $MPSHOCK$ over the early sample actually enters with an unexpected positive sign, although with a small point estimate. It is clear, as suggested by the literature reviewed above, that the bank lending interest channel for monetary policy was muted over this sub-period.

Columns 5 and 6 report our results for our late-sample period, either with the pandemic time dummy included (Column 5), or with the pandemic period dropped entirely (Column 6). For either specification, the results imply a much more robust monetary policy interest rate channel for bank lending. Our coefficient estimates for the variable of interest $MPSHOCK$ for this sub-sample enter significantly negative, as expected, and with substantively larger point estimates than those we observed for our full sample. Using our standard error estimates, these point estimates imply that a 25 basis point increase in $MPSHOCK$, holding all else equal, would be predicted to result in a 12.5 basis point reduction on average in bank lending in average annualized lending growth.

Removing the pandemic period observations in column 6, our point estimates increase so that the same 25 basis point positive monetary policy shock would be associated with a 15 basis point reduction annualized reduction in bank lending growth on average. The pandemic period therefore appears to reduce the observed efficacy of the bank lending channel somewhat, which would be in keeping with the low policy rates that prevailed during some of this event.[13]

[13]Reductions in the absolute values of estimated coefficients on $MPSHOCK$ for the late sample when the pandemic period is included may also reflect greater mismeasurement of the Bauer and Swanson (2023) monetary policy shocks during the pandemic period. Recall that concerns over the quality of the orthogonalized shock series inspired Bauer and Swanson (2023) to not report their orthogonalized series for two of our sample period half years during the pandemic.

IV.2. **Late sample results by bank size.** Given that we find a robust conventional bank lending channel on average over our late sample period (2017H1-2023H2), we next divide that late-sample into small, medium, and large bank sub-groups by lending size. We report results for each sub-group with and without the inclusion of observations from the pandemic period (Columns 1-3 and 4-5 respectively).

Our results are reported in Table 3, with columns 1 through 3 corresponding to the late sub-sample results for small, medium, and large banks with the pandemic period observations included, and columns 4 through 6 corresponding to the late sub-sample results for small, medium, and large banks with the pandemic period observations excluded.

Our variable of interest, $MPSHOCK$, continues to enter negatively for all bank size sub-groups. However, our results indicate a notable discrepancy between the sensitivity of banks to monetary policy shocks by size. Small banks are estimated to have the highest sensitivity, medium-sized banks are next and large banks have the lowest sensitivity. Our negative coefficient estimates enter with statistical significance for small and medium-sized banks, but not for large banks. These results hold with or without the inclusion of the pandemic period observations. Our finding of higher sensitivity to monetary policy shocks among small and medium-sized banks relative to their large bank counterparts is consistent with patterns that were found to prevail prior to the global financial crisis (e.g. Kashyap and Stein (2000)).

Our point estimates with pandemic period observations included indicate that a 25 basis point increase in MPSHOCK would result on average in a 16.3, 11.0, and 1.2 basis point decrease in annualized bank lending growth on average for the small, medium, and large bank subgroups respectively. Estimates for the small, medium, and large bank subgroups with the pandemic period observations dropped (columns 4-6) are similar.

Overall, our results for the late-sample bank size sub-groups are indicative of a return to conventional patterns in the bank lending response to monetary policy shocks subsequent to policy liftoff. These include both the conventional significant negative relationships between monetary shocks and bank lending growth and the relatively higher coefficient estimates obtained for small and medium-sized banks relative to larger banks.

Table 3. Late Period Split by Bank Size

	Including Pandemic Period			Excluding Pandemic Period		
	Small	Med.	Lg.	Small	Med.	Lg.
MPSHOCK	-0.3263***	-0.2190***	-0.0237	-0.3028***	-0.2389***	-0.0622
	(0.0080)	(0.0505)	(0.0947)	(0.0087)	(0.0561)	(0.1145)
LIQUID	0.0740***	-0.0545	0.2248*	0.1132***	-0.0575	0.1820
	(0.0086)	(0.0626)	(0.1218)	(0.0102)	(0.0896)	(0.1385)
DEPOSITS	0.1366***	0.0307	0.0485	0.1154***	0.0560	0.1066
	(0.0129)	(0.0657)	(0.1328)	(0.0140)	(0.0829)	(0.1411)
TIER1CAP	0.6402***	0.0383	0.9222**	0.5946***	0.1794	0.9549**
	(0.0385)	(0.3258)	(0.3899)	(0.0417)	(0.3610)	(0.4361)
PROB	-1.0271***	-1.9918***	-2.9137**	-1.0135***	-2.0961***	-4.2300***
	(0.0600)	(0.5150)	(1.2110)	(0.0651)	(0.7121)	(1.3022)
Constant	-0.1866***	0.1746***	0.0054	-0.1580***	0.1195*	-0.0621
	(0.0119)	(0.0555)	(0.1078)	(0.0135)	(0.0696)	(0.1114)
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y	Y
Observations	58255	1263	345	48838	1058	287

Note: OLS estimation with standard errors clustered by bank in parentheses for sample period 2017H1-2023H2. Cols. 1-3 report results for small medium, and large banks respectively with pandemic period observations included, and cols. 4-6 report results with pandemic period observations omitted. Dependent variable is $\%\Delta LEND$, average growth in bank lending from period t through $t+1$. Variable of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are avilable in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

V. Full sample with interactive term

The periods before and after our sample split in 2016H2 correspond to quite different average values of the federal funds rate, with the average value of the funds rate for our early sample at 0.17 and the average for our late sample at 1.95. The associated disparity in the strength of the bank lending interest rate channel shown in the previous section suggests that the federal funds rate level may play a role in determining the efficacy of the interest rate channel. This would match theory predicting a weakened bank lending channel at sufficiently low rates of interest.

In this section, we move to test this possibility directly. We estimate our full time series, but add a qualitative variable, $HIFFR$, which takes value 1 if the funds rate is greater than 0.5, and 0 otherwise. Ulate (2021) identifies 0.5 as the value below which banks started experiencing lending and profitability difficulties. We interact this variable with the monetary policy shock in $MPSHOCKxHIGHFFR$. These two variables are then added to our base specification.

Our new specification satisfies:

$$\%\Delta LEND_{i,t+1} = c + \beta_1 MPSHOCK_{t,t-1} + \beta_2 MPSHOCK_{t,t-1} xHIFFR_t \qquad (2)$$
$$+\beta_3 HIFFR_t + \gamma X_{i,t} + \eta Z_t + \phi_i + \epsilon_{i,t}$$

where β_1 and β_2 now combine as our coefficient estimates of interest, with β_1 corresponding to the point estimate for the average bank lending response to monetary shocks when the federal funds rate is below 0.5, and $\beta_1 + \beta_2$ corresponding to the point estimate for the average bank lending response to monetary shocks when the federal funds rate is above 0.5. $X_{i,t}$ denotes the bank-specific conditioning variables, $LIQUID_{i,t}$, $DEPOSITS_{i,t}$, $TIER1CAP_{i,t}$, and $PROB_{i,t}$; Z_t denotes the time-specific conditioning variables, ΔGDP_t, $PROP_t$, VIX_t, $\Delta PROP_t$ and ΔVIX_t; ϕ_i represents bank fixed effects, and $\epsilon_{i,t}$ is the regression residual. To address potential correlation in standard errors across banks, we again cluster our standard errors by bank.

Our results are shown in Table 4. Column 1 estimates our specification for the full sample. Column 2 reports weighted least squares estimation with observations weighted by bank lending in 2019H2.[14] Columns 3, 4, and 5 then report our results for the full time period for the small, medium, and large bank subgroups, respectively.

We obtain positive and statistically significant coefficient point estimates for the $MPSHOCK$ variable alone at at least a 10% confidence level for all specifications. As discussed above, this coefficient estimate can be interpreted as our results for periods where the federal funds rate lies below the 0.5 level which has been associated

[14]For banks that failed prior to 2019H2, their weights are based on prevailing values in their last period for which data was available.

Table 4. High Federal Funds Rate Interaction

	Full	WLS	Small	Med.	Lg.
MPSHOCK	0.0112**	0.0524**	0.0091**	0.0915**	0.1154*
	(0.0046)	(0.0232)	(0.0046)	(0.0380)	(0.0662)
MPSHOCKxHIGHFFR	-0.3085***	-0.1465***	-0.3097***	-0.3114***	-0.1266
	(0.0070)	(0.0387)	(0.0071)	(0.0477)	(0.0835)
HIGHFFR	-0.0005	-0.0081**	-0.0005	0.0005	0.0019
	(0.0008)	(0.0042)	(0.0008)	(0.0055)	(0.0086)
LIQUID	0.0572***	0.1067***	0.0569***	0.0465	0.1231**
	(0.0063)	(0.0328)	(0.0063)	(0.0714)	(0.0559)
DEPOSITS	0.0993***	0.0180	0.1094***	0.0007	-0.0459
	(0.0097)	(0.0474)	(0.0097)	(0.0684)	(0.1187)
TIER1CAP	0.4630***	0.2116*	0.4894***	0.0091	0.0064
	(0.0273)	(0.1146)	(0.0275)	(0.2249)	(0.2381)
PROB	-1.2057***	-0.9101***	-1.2008***	-1.7662***	-1.6190**
	(0.0339)	(0.3531)	(0.0342)	(0.3160)	(0.7166)
Constant	-0.1028***	0.0753**	-0.1174***	0.1508***	0.1240
	(0.0089)	(0.0379)	(0.0090)	(0.0434)	(0.0918)
Bank fixed effects	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y
Observations	123721	115934	120522	2540	659

Note: Standard errors clustered by bank in parentheses for sample period 2017H1-2023H2. Columns 1 reports full sample results under OLS. Column 2 reports full sample results with observations weighted by bank lending in 2019H2. Columns 3,4, and 5 report results for small medium, and large banks respectively under OLS. Dependent variable is $\%\Delta LEND$, average growth in bank lending from period t through $t+1$. Variables of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t and $MPSHOCKxHIGHFFR$, $MPSHOCK$ interacted with an indicator, $HIGHFFR$,that takes value 1 if the federal funds rate is greater than 0.5 and 0 otherwise. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are available in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

with banking difficulties in the literature. Indeed, our results are comparable to those we obtained for the early period above when we separated the sample at policy liftoff.[15]

The coefficients on our interactive variable, $MPSHOCKxHIGHFFR$ are negative and larger in absolute value than those we obtained for $MPSHOCK$ on its own for all specifications, confirming that our point estimate for bank lending responses to monetary shocks are consistent with a conventional bank lending channel for periods with the federal funds rate exceeding 0.5%. However, our coefficient point estimate for the large bank sub-sample (column 6) is insignificant. As a result, an F-test fails to reject the null that the sum of these coefficients is different from 0 at a 1% confidence level. In contrast, specifications for our full sample and small and mid-sized bank sub-sample specifications all reject the null at a 1% confidence level. Notably for the overall lending response of the banking system, this includes our specification for the full sample weighted by bank lending levels (Column 2).

Our coefficient estimates for $HIGHFFR$ in isolation are statistically insignificant for all specifications except the full sample with weighting by bank lending. This suggests that the average conditions associated with the federal funds rate being above the 50 basis point threshold do not influence bank lending growth on their own. The exception, the full sample weighted by bank lending in Column 2, enters with an unexpected negative sign, suggesting that elevated activity at higher levels of the federal funds rate are not driving our bank lending channel results, as if that were the case we would expect a positive coefficient estimate on this variable.

Our point estimates for periods with the federal funds rate exceeding 0.5 indicate that a 25 basis point increase in $MPSHOCK$ is predicted to result on average in 14.9, 4.7, 15.0, 11.0, and 0.6 basis point annualized reductions in bank lending growth for the full, weighted least squares, small, medium, and large bank specifications respectively. Our finding that the response by large banks is smaller in absolute value than those for both small and medium-sized banks at levels of the federal funds rate exceeding 0.5 supports the result in the literature based on pre-global financial crisis data that large bank lending is on average less sensitive to monetary policy shocks (Kashyap and Stein (2000)).

VI. Small business lending

Lastly, we reestimate our interactive specification with the dependent variable changed to $\%\Delta SBLEND$, the percent change in small business lending. We follow

[15]These results are available in online appendix Table OA.3

the Call Report definition of small business lending, which classifies business loans of $1 million or less as small business lending. While this is not a perfect proxy for small business lending, it is widely used in the literature as the share of loans of this size directed towards large businesses is small (e.g. Lopez and Spiegel (2023)).

Our results are shown in Table 5. Column 1 again reports our full sample specification. We obtain negative and statistically significant coefficient estimates for both $MPSHOCK$ and $MPSHOCKxHIGHFFR$, implying a conventional small business lending response at both low and high policy rates. However, the coefficient point estimates are quite different, with $MPSHOCKxHIGHFFR$ larger in absolute value.

As a result, our point estimates suggest a larger disparity in the small business lending response to monetary shocks under conventional interest rates relative to low interest rate than we observed for the total lending response above. Our point estimates for our full sample specification (Column 1) indicate that a 25 basis point increase in $MPSHOCK$ will result in only a 2.5 basis point decrease in the annualized rate of growth of small business lending on average for periods with the federal funds rate below 50 basis points, while the same 25 basis point policy shock would result in a 48.2 basis point decrease in annualized small business lending growth for periods with the funds rate above 50 basis points.

Column 2 repeats the full sample specification with observations weighted by bank lending. We again obtain significantly negative coefficient estimates for both variables of interest, suggesting that our finding of conventional small business lending responses under both low and high policy rates is robust to weighting by bank lending, but the disparity between the point estimates on the responses is even larger. Our point estimates suggest that a 25 basis point increase in $MPSHOCK$ will result in only a 2.5 basis point decrease in the annualized rate of growth of small business lending on average for periods with the federal funds rate below 50 basis points, while the same 25 basis point policy shock would result in a 71.6 basis point decrease in annualized small business lending growth for periods with the funds rate above 50 basis points.

Columns 3, 4, and 5 report results for small, medium, and large bank sub-samples respectively. Our qualitative results for the small and medium-sized banks are similar to those we obtain for total lending, with both the coefficient estimate for $MPSHOCK$ and $MPSHOCKxHIGHFFR$ entering negatively, although the coefficient estimate on the interactive term is now insignificant for the mid-sized bank sub-sample. However, unlike our results for overall lending, the interactive term for the large bank

TABLE 5. Small Business Lending

	Full	WLS	Small	Med.	Lg.
MPSHOCK	-0.0504***	-0.0993**	-0.0491***	-0.1056	-0.0666
	(0.0093)	(0.0417)	(0.0094)	(0.0762)	(0.1082)
MPSHOCKxHIGHFFR	-0.9135***	-1.4311***	-0.8986***	-1.4880***	-1.4599***
	(0.0188)	(0.1184)	(0.0189)	(0.1355)	(0.2807)
HIGHFFR	0.0447***	0.0945***	0.0434***	0.0863***	0.1266***
	(0.0017)	(0.0171)	(0.0017)	(0.0125)	(0.0203)
LIQUID	0.0225**	0.0863	0.0211**	0.1225	0.3694*
	(0.0106)	(0.1503)	(0.0107)	(0.0866)	(0.1919)
DEPOSITS	0.0460***	-0.1229	0.0598***	-0.1961*	-0.3770*
	(0.0157)	(0.0772)	(0.0156)	(0.1107)	(0.2210)
TIER1CAP	0.4880***	-0.2478	0.5166***	-0.0402	-0.5180
	(0.0427)	(0.4069)	(0.0424)	(0.2588)	(0.7217)
PROB	-0.9457***	-0.9174	-0.9348***	-1.5417**	-1.9266
	(0.0540)	(0.6145)	(0.0543)	(0.6016)	(1.4057)
Constant	-0.0415***	0.1525*	-0.0578***	0.2812***	0.2966*
	(0.0145)	(0.0791)	(0.0144)	(0.0943)	(0.1684)
Bank fixed effects	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y
Observations	118026	110647	115057	2360	609

Note: Standard errors clustered by bank in parentheses for sample period 2017H1-2023H2. Columns 1 reports full sample results under OLS. Column 2 reports full sample results with observations weighted by bank lending in 2019H2. Columns 3,4, and 5 report results for small medium, and large banks respectively under OLS. Dependent variable is $\%\Delta SBLEND$, average growth in bank small business lending from period t through $t+1$. Variables of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t and $MPSHOCKxHIGHFFR$, $MPSHOCK$ interacted with an indicator, $HIGHFFR$, that takes value 1 if the federal funds rate is greater than 0.5 and 0 otherwise. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are available in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

small business lending response is large in absolute value and statistically significant at a 1% confidence level.

Our point estimates suggest that a 25 basis point increase in $MPSHOCK$ will result in 2.5, 5.0, and 3.3 basis point decreases in the annualized rate of growth of small business lending on average for periods with the federal funds rate below 50 basis points for the small, medium, and large bank sub-samples respectively. In contrast, the same 25 basis point policy shock would result in much larger 47.4, 79.7, and 76.3 basis point decreases in annualized small business lending growth for periods with the funds rate above 50 basis points.

The stronger responsiveness we observe for small business lending relative to that observed for overall lending for large banks is intuitive. Small banks are likely to be associated with longer-term relationships with small businesses, which also comprise a large share of their overall lending portfolio than large banks, and hence less responsive to short-term fluctuations in policy rates than large banks.[16]

VII. Conclusion

This paper revisits the strength of the interest rate channel for monetary policy. Literature during the low-interest rate period following the global financial crisis demonstrated that banks could experience difficulties in lending and profitability in the neighborhood of the zero lower bound. The theory behind this conjecture also implies that lending conditions should have improved after policy rates returned to normal levels. Sufficient time since that date affords us the opportunity to assess whether the responsiveness of bank lending to monetary policy shocks has indeed recovered.

Our results identify a viable interest rate channel for bank lending during the later period of our sample, after policy liftoff returned the federal funds rate to more conventional levels. The increased responsiveness of bank lending under conventional policy rates suggests that low rates following the global financial crisis drove the weakness of the interest rate channel in the earlier period. While the pandemic period proved disruptive to both economic activity and bank lending, our results suggest that the renewed viability of bank lending subsequent to policy liftoff is robust to the inclusion or exclusion of the pandemic period in our sample.

[16]While the notion that small banks have advantages in relationship lending to small businesses due to their comparative advantage in generating "soft information," about borrowers, Berger and Black (2011) find that this advantage is greatest for small bank lending to larger firms.

We then investigate the possibility of disparities by bank size for the later period. We separate the sample into small, medium and large subgroups and identify differences in responsiveness, with medium-sized banks being the most responsive, small banks being second, and large banks being the least sensitive. This matches patterns in the data found to prevail prior to the global financial crisis, and provides additional evidence that the interest rate channel has returned to normal subsequent to policy liftoff in the previous decade.

Finally, we return to our full time series and interact the monetary policy shock variable with an interactive indicator of conventional values of the funds rate, corresponding to the funds rate exceeding the fifty basis point threshold identified in the literature as the level below which the proximity to the zero lower bound leads to difficulties in financial intermediation and bank profitability. We confirm the existence of a robust monetary policy channel for bank lending at conventional policy rate levels. We obtain even stronger evidence of a bank lending channel for small business lending under the same specification at conventional policy rate levels. The heightened sensitivity of bank lending to monetary policy shocks during periods of elevated interest rates suggests that the efficacy of the bank lending channel has returned to normal since policy rate liftoff.

In assessing the implications of these findings, it is important to acknowledge that the level of the federal funds rate is endogenous to economic conditions, as it reflects responses by policymakers to prevailing activity levels and inflation. We therefore interpret our finding of a role for the level of the funds rate in explaining the sensitivity of bank lending to monetary policy shocks as not only representing the policy rate itself, but also the economic conditions that led to the adoption of that policy rate. Moreover, as our indicator variable changes very slowly over the course of our sample, the results are unlikely to be biased by endogenous movements above or below this threshold in our sample.

Still, our analysis is unable to discriminate between the two potential channels identified in the literature as possible reasons as to *why* we find reduced responsiveness of banks to monetary policy shocks at low rates of interest. As discussed in the literature, the heightened responsiveness of bank lending to monetary policy shocks could be due to either the reduced net interest margins enjoyed by banks under low policy rates or the weaker economic conditions that tend to accompany those low policy rates, and are likely to reflect both.

References

Abadi, J., M. Brunnermeier, and Y. Koby (2023). The reversal interest rate. *American Economic Review 113*(8), 2084–2120.

Altavilla, C., M. Boucinha, and J.-L. Peydró' (2018, October). Monetary policy and bank profitability in a low interest rate environment. *Economic Policy*, 531–586.

Altavilla, C., L. Burlon, M. Gianetti, and S. Holton (2022). Is there a zero lower bound? the effects of negative policy rates on banks and firms. *Journal of Financial Economics 144*, 885–307.

Ampudia, M. and S. J. V. den Heuvel (2022). Monetary policy and bank equity values in a time of low and negative interest rates. *Journal of Monetary Economics 130*, 49–67.

Andrade, P., C. Cahn, H. Fraisse, and J.-S. Mésonnier (2019). Can the provision of long-term credit help to avoid a credit crunch? evidence from the eurosystem's ltro. *Journal of the European Economic Association 17*(4), 1070–1106.

Bauer, M. D. and E. T. Swanson (2023). A reassessment of monetary policy surprises and high-frequency identification. *NBER Macroeconomics Annual 37*, 87–155.

Berger, A. N. and L. K. Black (2011). Bank size, lending technologies, and small business finance. *Journal of Banking and Fiannce 35*(3), 901–921.

Bernanke, B. S. and A. S. Blinder (1992). The federal funds rate and the channels of monetary transmission. *American Economic Review 82*, 901–921.

Borio, C. and B. Hofmann (2017, April). Is monetary policy less effective when interest rates are persistently low? Bank for International Settlements Working Paper No. 628.

Burietz, A. and M. Picault (2023). To lend or not to lend? the ecb as the 'intermediary of last resort'. *Economic Modelling 122*(106228).

Cetorelli, N. and L. S. Goldberg (2012). Banking globalization and monetary transmission. *Journal of Finance 67*(6), 1811–1843.

Ciccarelli, M., A. Maddaloni, and J.-L. Peydro (2015). Trusting the bankers: A new look at the credit channel of monetary policy. *Review of Economic Dynamics 18*(4), 979–1002.

Diamond, D. and R. Rajan (2011). Fear of fire sales, illiquidity seeking, and credit freezes. *Quarterly Journal of Economics 126*, 557–591.

Eggertson, G. B., R. E. Juelsrud, L. H. Summers, and E. G. Wold (2024). Negative nominal interest rates and the bank lending channel. *Quarterly Journal of Economics 91*, 2201–2275.

Gambacorta, L. (2005). Inside the bank lending channel. *European Economic Review 49*(7), 1737–1759.

Genay, H. and R. Podjasek (2014). What is the impact of a low interest rate environment on bank profitability? *Chicago Fed Letter 324*.

Greenwald, D., J. Krainer, and P. Paul (2024, May). Monetary transmission through bank securities portfolios. NBER working paper 32449.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2012, August). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review 102*(5), 2301–2326.

Kashyap, A. K. and J. C. Stein (1994, January). Monetary policy and bank lending. In N. G. Mankiw (Ed.), *Monetary Policy*, San Francisco, CA. National Bureau of Economic Research: The University of Chicago Press.

Kashyap, A. K. and J. C. Stein (2000, June). What do a million observations on banks say about the transmission of monetary policy? *American Economic Review 90*, 407–428.

Lopez, J. A., A. K. Rose, and M. M. Spiegel (2020, May). Why have negative nominal rates had such a small effect on bank performance? cross-country evidence. *European Economic Review 124*(103402).

Lopez, J. A. and M. M. Spiegel (2023, January). Small business lending under the ppp and ppplf programs. *Journal of Financial Intermediation 53*(101017).

Naqvi, H. and R. Pungaliya (2023). Bank size and the transmission of monetary policy: Revisiting the lending channel. *Journal of Banking and Finance 146*(106688).

Oliner, S. D. and G. D. Rudebusch (1995). Is there a bank lending channel for monetary policy? *Federal Reserve Bank of San Francisco Economic Review 2*.

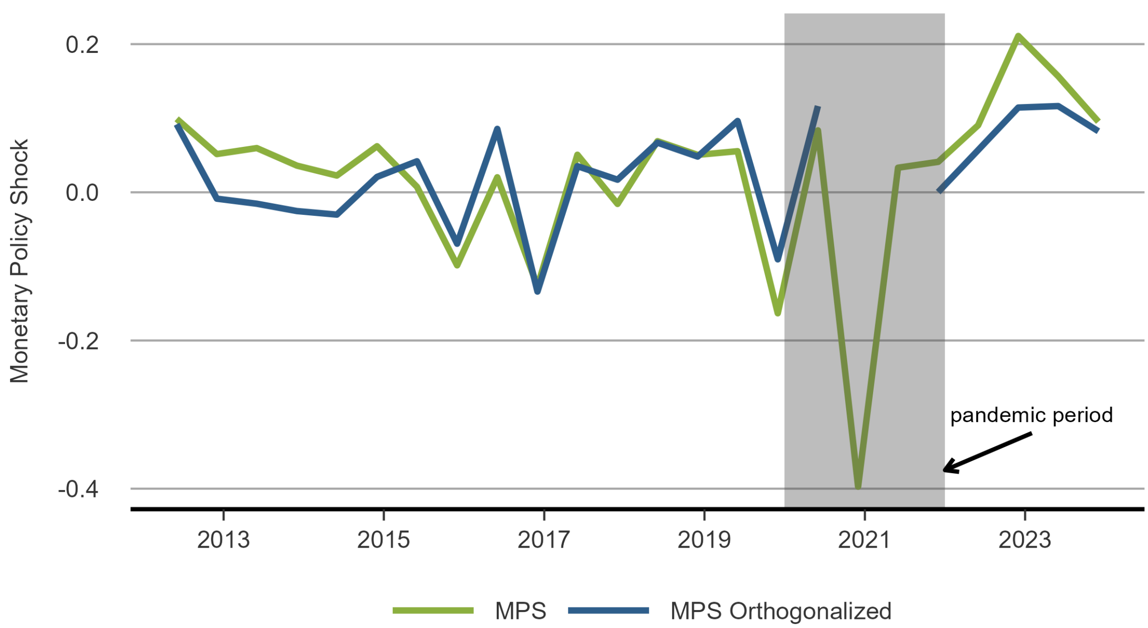
Paul, P. (2022, December 20). When the fed raises rates, are banks less profitable? *Federal Reserve Bank of San Francisco Economic Letter 2022-35*.

Romer, C. D. and D. H. Romer (1990). New evidence on the monetary transmission mechanism. *Brookings Papers on Economic Activity 1*, 149–213.

Ulate, M. (2021, January). Going negative at the zero lower bound: The effects of negative nominal interest rates. *American Economic Review 111*(1), 1–40.

Appendix

Figure A1. Half-Yearly Aggregated Monetary Policy Shocks



Note: Half-yearly sums of monetary policy shocks for Bauer and Swanson (2023). Green line represents raw shocks, while blue line represents shocks orthogonalized for changes in macroeconomic conditions.

Table A1. Split sample in 2015 or 2016

	Early	Late	Late, Drop Pand.	Early	Late	Late, Drop Pand.
MPSHOCK	-0.1050**	-0.1004***	-0.0869***	-0.1302***	-0.1331***	-0.1502***
	(0.0448)	(0.0043)	(0.0046)	(0.0116)	(0.0045)	(0.0061)
LIQUID	0.2274***	0.0838***	0.1014***	0.1855***	0.0903***	0.1104***
	(0.0137)	(0.0075)	(0.0087)	(0.0120)	(0.0079)	(0.0091)
DEPOSITS	0.2195***	0.0954***	0.0910***	0.1809***	0.0995***	0.1001***
	(0.0279)	(0.0106)	(0.0115)	(0.0224)	(0.0117)	(0.0126)
TIER1CAP	1.0007***	0.5881***	0.5996***	0.8349***	0.6164***	0.6059***
	(0.0649)	(0.0337)	(0.0364)	(0.0492)	(0.0356)	(0.0386)
PROB	-0.9495***	-1.0407***	-1.0048***	-1.0388***	-1.0203***	-0.9967***
	(0.0557)	(0.0496)	(0.0515)	(0.0483)	(0.0541)	(0.0573)
Constant	-0.5785***	-0.1332***	-0.1111***	-0.5206***	-0.1439***	-0.1639***
	(0.0458)	(0.0099)	(0.0112)	(0.0277)	(0.0106)	(0.0121)
Bank fixed effects	Y	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y	Y
Observations	40081	83640	73960	52238	71483	61803

Note: Repeat of base specification in Table 2 in text with samples split into early and late sub-samples at earlier dates. Columns 1-3 begin late sample period at 2015H1, while columns 4-6 begin late sample period at 2016H1. Variables of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t and $MPSHOCKxHIGHFFR$, $MPSHOCK$ interacted with an indicator that takes value 1 if the federal funds rate is greater than 0.5 and 0 otherwise. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are available in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE A2. Non-Orthogonalized Shocks

	Full	2012-2016	2017-2023	Full	Small	Medium	Large
MPSHOCK	-0.0300***	0.0319***	-0.0792***	0.0452***	0.0436***	0.0972**	0.1066
	(0.0021)	(0.0064)	(0.0037)	(0.0050)	(0.0051)	(0.0376)	(0.0719)
LIQUID	0.0706***	0.1506***	0.1055***	0.0661***	0.0663***	0.0329	0.1068*
	(0.0061)	(0.0105)	(0.0077)	(0.0064)	(0.0064)	(0.0739)	(0.0543)
DEPOSITS	0.1020***	0.1485***	0.1534***	0.0939***	0.1035***	-0.0070	-0.0788
	(0.0093)	(0.0194)	(0.0117)	(0.0096)	(0.0096)	(0.0686)	(0.1138)
TIER1CAP	0.4487***	0.7162***	0.6291***	0.4640***	0.4889***	0.0370	0.0688
	(0.0272)	(0.0435)	(0.0383)	(0.0274)	(0.0276)	(0.2282)	(0.2472)
PROB	-1.1976***	-1.1483***	-1.0401***	-1.2236***	-1.2187***	-1.7782***	-1.5683**
	(0.0336)	(0.0445)	(0.0573)	(0.0337)	(0.0340)	(0.3132)	(0.7147)
HIGHFFR				-0.0013*	-0.0014*	0.0013	0.0013
				(0.0008)	(0.0008)	(0.0054)	(0.0068)
MPSHOCKxHIGHFFR				-0.3739***	-0.3748***	-0.3749***	-0.1897*
				(0.0096)	(0.0098)	(0.0605)	(0.1057)
FEDFUNDS				0.0012***	0.0013***	-0.0012	-0.0001
				(0.0004)	(0.0004)	(0.0024)	(0.0053)
Constant	-0.0996***	-0.1171***	-0.2376***	-0.1090***	-0.1235***	0.1638***	0.1609
	(0.0086)	(0.0201)	(0.0113)	(0.0089)	(0.0089)	(0.0435)	(0.1014)
Bank fixed effects	Y	Y	Y	Y	Y	Y	Y
Time cond. vars.	Y	Y	Y	Y	Y	Y	Y
Observations	133421	63858	69563	123721	120522	2540	659

Note: Repeat of base specification in Table 2 in text with data for monetary policy shocks taken from unorthogonolized series in Bauer and Swanson (2023). Sample includes all dates from the pandemic period, including 2020H2 and 2021H1 which are missing from orthogonolized Bauer and Swanson (2023) series and hence base specification sample . Variables of interest is $MPSHOCK$, cumulative monetary policy shocks from period $t-1$ through t and $MPSHOCKxHIGHFFR$, $MPSHOCK$ interacted with an indicator that takes value 1 if the federal funds rate is greater than 0.5 and 0 otherwise. Conditioning variables are measured as of period t and are normalized by total assets. These include $LIQUID$, bank total liquidity; $DEPOSITS$, bank deposits; $TIER1CAP$, bank tier 1 capital ratio; and $PROB$, bank past-due and non-accrual loans relative to total assets. Bank fixed effects included. See text for included time conditioning variables. Time conditioning variable coefficient estimates are avilable in the online appendix. Data sources: NIC Metadata/FFIEC, Bauer Swanson, FRED. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$