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How Does Monetary Policy Shock Affect Banks' Loan Loss Provisioning Behavior? Evidence from Chinese Commercial Banks*

By **Yong Ma, Huanqi Lan***

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Abstract

This study examines the impact of monetary policy shocks on banks' loan loss provisioning behavior using panel data from Chinese commercial banks. We find robust evidence that a positive monetary policy shock negatively affects banks' loan loss provisions (LLPs), as banks adjust LLPs to enhance reported earnings and conceal risks during periods of monetary tightening. Further analysis reveals that banks with higher risk profiles or weaker risk resilience exhibit larger reductions in LLPs in response to monetary policy shocks. Additionally, stricter macroprudential policies and higher regulatory quality encourage banks to maintain higher levels of LLPs. We also find that during periods of credit contraction, banks are less likely to reduce LLPs to bolster future earnings, as doing so poses greater risks. The findings underscore the importance of maintaining transparent and stable monetary policy to prevent distortions in banks' loan loss provisioning behavior and highlight the need for effective regulations to ensure that banks remain healthy and maintain adequate LLPs, particularly during economic and financial downturns.

JEL Classification: G21, G28, E52, M41

Keywords: Monetary policy shock; Loan loss provisions; Bank regulation

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1. Introduction

Although a large strand of literature has examined the impact of monetary policy on various bank behaviors, fewer attention has been devoted to the impact of monetary policy shock (MPS) on banks' loan loss provisioning behavior. Traditional literature devoted to the assessment of the relationship between monetary policy and bank behavior has primarily focused on interest rate or money growth as indicators of monetary policy. However, such indicators may not accurately represent a monetary policy shock since their movements can be endogenous as a response to changes in economic conditions. In comparison to anticipated changes in monetary policy, MPS operates as an unexpected event and thus assumes a distinct role in influencing bank behavior.

Our study attempts to examine the changes in bank behavior resulting from MPS from the perspective of banks' loan loss provisions (LLPs). The reason for selecting LLPs as the focal point of this study is twofold. On the one hand, banks play a crucial role in the transmission of monetary policy, and LLPs serve as a vital signal for banks' downstream customers (Wahlen, 1994; Beaver & Engel, 1996; Liu et al., 1997; Kanagaretnam et al., 2005). Consequently, the appropriate adjustment of LLPs by banks and the accurate signal they convey when confronted with MPS hold critical significance for the smooth transmission of such shocks. On the other hand, banks possess the discretionary power over LLPs, enabling them to more promptly reflect the expectation adjustments and behavioral changes that banks undergo in response to MPS. This discretion empowers LLPs to act as a responsive barometer, shedding light on the dynamic shifts in bank behavior triggered by unexpected policy adjustments.

According to the traditional theory of monetary policy, a tightening stance by the central bank typically prompts an increase in banks' LLPs. Specifically, elevated interest rates tend to impede economic growth by rendering borrowing more expensive. As a consequence, firms and households will find it more challenging to repay bank loans, which heightens the risk of default. In this case, banks will find it necessary to allocate additional funds to provisions to account for the expected losses stemming from troubled loans. However, in sharp contrast to this conventional wisdom, our study shows that banks would reduce their LLPs in response to a contractionary MPS. In Fig.1, we plot the time series of China's MPS and the median ratio of banks' LLPs in our sample, from which we can see that the time series of LLPs exhibit a strong countercyclical behavior in response to MPS. Does this observation challenge the validity of the traditional theory of monetary policy? Why does an increase in MPS lead to outcomes contrary to the predictions of the conventional wisdom? In this paper, we attempt to analyze this counter-intuitive phenomenon by investigating whether and how MPS may affect banks' loan loss provisioning behavior.

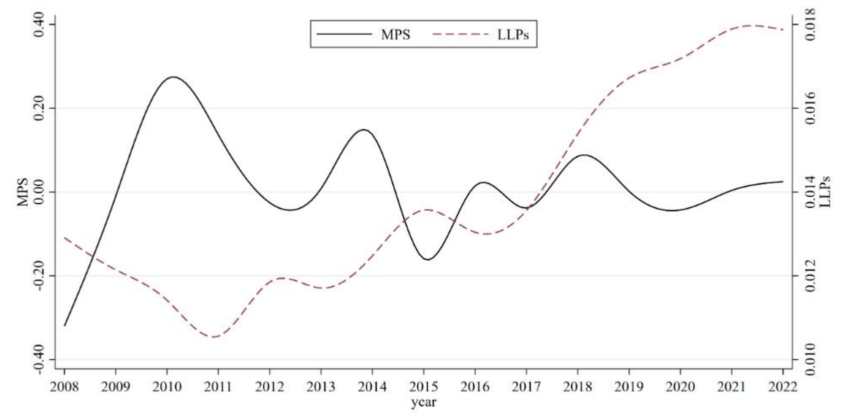

Fig. 1 Monetary policy shock and bank LLPs: 2008–2022

Notes: (1) This figure shows the time series of the monetary policy shock (MPS) and the median loan loss provisions (LLPs) of sample banks over the period of 2008–2022; (2) MPS is calculated as the changes in the 1-year interest rate swap of the 7-day fixing repo rate (FR007–IRS) before and after the monetary policy announcements from the People's Bank of China. An increase in MPS reflects an unexpected tightening of monetary policy, and vice versa. (3) LLPs are loan loss provisions scaled by total assets.

Given the signaling role of LLPs in the transmission and feedback processes of monetary policy, the issue we investigate carries significant theoretical and policy implications. Banks play a crucial role in monetary policy transmission, with changes in LLPs serving as key signals to downstream borrowers (Wahlen, 1994; Beaver & Engel, 1996; Liu et al., 1997; Kanagaretnam et al., 2005). Inappropriate adjustments to LLPs can send misleading signals and potentially exacerbate financial volatility (Agénor & Zilberman, 2015). Notably, recent years have seen growing concern over the impact of bank characteristics on monetary policy transmission (Gambacorta & Shin, 2018; Abuka et al., 2019; Albertazzi et al., 2021; Morales et al., 2022; Naqvi & Pungaliya, 2023). This study offers a new perspective by emphasizing the role of banks' adjustments to LLPs. Determining whether these adjustments in response to monetary policy shocks are appropriate is crucial for effective policy-making. For monetary authorities, our findings highlight potential inefficiencies in the bank lending channel, which, if addressed, could enhance the overall effectiveness of monetary policy.

Beyond transmitting monetary policy signals to downstream borrowers, LLPs also function as a feedback mechanism for upstream monetary authorities, indicating how banks adjust their behavior in response to policy changes. The existing literature often interprets higher LLPs as indicative of increased bank risk-taking. For instance, Degryse and Huylebroek (2023) employ LLPs to assess the impact of fiscal support measures during the pandemic, suggesting that a decline in LLPs reflects reduced loan portfolio risk. However, our research uncovers a more nuanced relationship. Specifically, we find that lower LLPs do not necessarily indicate reduced risk. Instead, banks with higher risk profiles are more likely to decrease their LLPs to inflate reported earnings. This insight provides policymakers with a more comprehensive framework for interpreting the signals conveyed by LLPs, thereby enhancing their ability to assess the effectiveness and potential unintended consequences of monetary policy interventions.

In general, there are three major arguments for the purposes of loan loss provisioning: capital management, earnings signaling and income smoothing (e.g., Ahmed et al., 1999; Kanagaretnam et al., 2005; Elnahass et al., 2014; Skała, 2015; Ozili & Outa, 2017; Peterson & Arun, 2018). Concerning capital management, bank managers may strategically adjust LLPs to meet the minimum regulatory capital requirements. Empirical evidence has demonstrated a negative correlation between LLPs and capital levels (e.g., Moyer, 1990; Ahmed et al., 1999). The earnings signaling hypothesis posits that bank managers utilize LLPs as a signal of the quality of the bank's loan portfolios or its future earnings prospects. An increase in LLPs can be interpreted as a positive signal, with empirical evidence showing positive correlation between LLPs and future earnings or cash flows (e.g., Wahlen, 1994; Kanagaretnam et al., 2003). However, an increase in LLPs can also be perceived as an indication of adverse news regarding loan defaults (e.g., Beaver & Engel, 1996; Liu et al., 1997; Kanagaretnam et al., 2005). In addition, bank managers also have the motivation to maintain high LLPs during periods of elevated earnings, thereby mitigating the volatility of reported earnings. This income smoothing argument is supported by empirical findings documenting a positive relationship between LLPs and bank earnings (e.g., Kanagaretnam et al., 2003; Ozili, 2019).

Notably, prior studies have proposed three main explanations for banks' practices in loan loss provisioning; however, none have explored the specific implications of adjustments to LLPs in response to monetary policy shocks. A reduction in LLPs can either signal a decline in bank risk-taking or reflect efforts to improve financial statements. Thus, a rigorous empirical analysis is crucial to accurately assess the implications of banks' LLP adjustments in the context of MPS.

In this study, we complement the previous studies by showing that an increase in MPS will lead to a decrease in bank LLPs. This result remains robust after controlling for potential endogeneity, and a variety of robustness checks further confirm the validity of the result. Our findings show that banks tend to conceal underlying risks and use LLPs as a tool to manage ("dress up") reported earnings in the current period. This results in sharp contrast to the findings in the previous studies (e.g., Ng et al., 2020; Danisman et al., 2021), where banks are found to use LLPs as a precautionary tool for absorbing future losses. In addition, further analysis suggests that a positive MPS leads to a decline in banks' loan performance and profitability. This implies that, when faced with contractionary MPS (tight monetary policy stance), banks reduce their LLPs not due to an improvement in loan performance, but rather in anticipation of a deterioration in loan performance. Moreover, mechanism analysis indicates that the impact of MPS on LLPs is more pronounced for banks characterized by higher levels of risk and poorer risk resilience.

Our study makes several significant contributions to the existing literature. First, we offer new insights into the determinants of banks' earnings manipulation. Previous research has predominantly focused on factors such as CEO characteristics (Kim et al., 2017; Miller & Xu, 2019; Buchholz et al., 2020), management incentives (Degeorge et al., 1999; Bergstresser & Philippon, 2006), and regulatory requirements (Ahluwalia et al., 2018; Ng et al., 2021; Owusu et al., 2022). However, the effect of monetary policy shocks on banks' earnings manipulation remains largely unexplored. In this study, we address this gap by developing a novel indicator to capture unexpected changes in monetary policy and examining its impact on banks' earnings manipulation practices.

Moreover, while profitability manipulation is a well-established concept in corporate finance for non-financial firms, far less attention has been devoted to banks' manipulation of LLPs in the context of monetary policy. Our study contributes to this literature by demonstrating that banks may adjust LLPs to mitigate the adverse effects of monetary policy shocks. This finding extends prior researches on the determinants of earnings manipulation, emphasizing the unique role of banks' LLP adjustments in monetary policy implementation.

Second, we contribute to the growing literature on how policy uncertainties influence banks' risk-taking behaviors (Ng et al., 2020; Danisman et al., 2021) by developing a novel measure of economic policy uncertainty. Prior studies (e.g., Ng et al., 2020; Danisman et al., 2021) have shown that heightened uncertainty prompts banks to increase their LLPs as a signal of anticipated loan losses to shareholders. In this study, we introduce an enhanced measure of policy uncertainty—monetary policy shock (MPS)—by distinguishing between contractionary and expansionary shocks. Our findings demonstrate that these two types of shocks lead to opposite adjustments in LLPs, thereby challenging the existing literature, which suggests that all forms of policy uncertainty uniformly result in higher LLPs. Additionally, we provide empirical evidence linking policy uncertainty to income smoothing, thus addressing a gap in the current research (Danisman et al., 2021).

Third, we contribute to the extensive literature on the transmission mechanisms of monetary policy. While classic studies have long emphasized the critical role of banks in transmitting monetary policy (Bernanke & Blinder, 1988, 1992; Kashyap & Stein, 2000; Jiménez et al., 2012), more recent studies have shifted focus to the influence of bank characteristics on various transmission channels, including bank size (Naqvi & Pungaliya, 2023), capital (Gambacorta & Shin, 2018), funding structures (Albertazzi et al., 2021), and the international expansion of domestic banks (Morales et al., 2022). Our study advances this literature by examining how banks' earnings manipulation influences the transmission of monetary policy, a factor that is critical for policymakers and clients alike, as such manipulations can undermine policy effectiveness and impact downstream stakeholders.

Finally, our findings contribute to the ongoing debate on the effectiveness of macroprudential regulation in shaping banks' provisioning behavior. Existing studies have reported mixed outcomes regarding the influence of regulation on banks' LLPs. For instance, Beck and Narayanamoorthy (2013) find that SEC interventions enhance the informativeness of LLPs—measured by their ability to predict future losses—for financially strong banks but diminish it for weaker banks. In contrast, Olszak et al. (2017) demonstrate that neither official oversight nor private-market monitoring effectively addresses banks' misuse of discretionary power in setting LLPs. Our study extends this literature by exploring how macroprudential regulation and regulatory quality influence banks' adjustments to LLPs. Our results indicate that stricter macroprudential policies and higher regulatory quality significantly curb the reduction of LLPs in response to positive monetary policy shocks. This implies that aligning macroprudential measures with monetary policy and enhancing regulatory standards can prevent banks from exploiting their discretion in LLP adjustments.

The structure of the paper is as follows: Section 2 reviews the relevant literature and develops the hypotheses. Section 3 outlines the methodology, data, and variables used in the study. Section 4 presents the empirical results and conducts robustness checks. Section 5 offers empirical evidence supporting the mechanism analysis. Section 6 delves into the effects of macroprudential regulation and credit contraction on the relationship between monetary policy shocks and banks' LLPs, as well as how banks' adjustments to LLPs in response to these shocks influence their capacity to attract deposits and issue loans. Finally, Section 7 concludes the paper and discusses policy implications.

2. Related literature and hypothesis development

In this paper, we focus on the impact of MPS on banks' loan loss provisioning behavior. LLPs are important accruals in banks, serving a pivotal role in absorbing anticipated loan losses (Ozili & Outa, 2017). Bank managers possess the discretion to adjust LLPs not only for mitigating potential risk, but also to fulfill opportunistic financial reporting objectives (Wahlen, 1994). Considering the impacts of MPS on bank credit and the expectations of bank managers, LLPs are expected to be closely related to MPS.

It is quite straightforward that MPS would have a negative impact on economic and financial activities. An increase in MPS, which means that monetary policy stance is tighter than unexpected, will reduce industrial production (Murgia, 2020), increase information asymmetry and firm risk (Nagar et al., 2019), and enhance macroeconomic uncertainties (Mumtaz & Theodoridis, 2020). All these would result in higher probability of firm default and thus diminish the quality of banks' loan portfolios and heighten banks' credit risk. In response to higher credit risk and deteriorating financial statements caused by MPS, banks may opt to keep higher loan loss accruals as a precautionary measure. Meanwhile, facing an increased default rate and a worsening liquidity position, banks would have to set aside more LLPs to offset the potential losses from non-performing loans.

However, considering the objective of maintaining excellent financial performance and the negative signal that falling LLPs may convey to bank customers, reducing LLPs may pose a threat to the career of bank managers. As a result, bank managers have a strong motivation to avoid the disclosure of negative information (Kothari et al., 2009), which induces them to hide or at least mitigate the "bad news" (higher credit risk and worse financial performance) by keeping less LLPs (Beatty et al., 2002; Cohen et al., 2014). In this case, bank managers would opportunistically use the discretion afforded to them (Barth et al., 2017) and increase reported earnings by reducing LLPs, where a negative relationship between MPS and LLPs is expected. Based on the above analysis, we propose the following hypothesis:

H1. *An increase in MPS leads to a decrease in LLPs.*

As discussed above, a main channel that reverses the effect of MPS on LLPs is the deterioration of banks' loan performance and bank managers' attempts to cover up the problem. As one can see, there are two key points embedded in the above mechanism: (i) the weakening effect of MPS on banks' loan performance and profitability, and (ii) banks' incentive to revise its LLPs downward to increase income. In particular, a positive MPS leads to a slowdown in credit growth and a reduction in investments (Chen et al., 2019), which increases default rate and results in more non-performing loans. In this case, banks with a higher proportion of loans in their assets, with an inherently greater risk of default on customer loans or with poorer risk resilience are more likely to understate LLPs in order to alleviate the negative effects of MPS on their earnings, as predicted by the "income smoothing argument" and the "earnings signaling argument". Based on the above analysis, we propose the following two hypotheses:

H2. *An increase in MPS results in worse loan performance and bank profitability, manifested by an increase in non-performing loans and a decrease in profit before tax.*

H3. *An increase in MPS leads to a greater reduction in LLPs for banks with higher loan-to-value ratios, more non-performing loans, and lower provision coverage ratios.*

3. Methodology and data

3.1. Methodology

Following the previous studies (e.g., Ng et al., 2020; Berger et al., 2022), we use fixed effects (FE) model with robust standard errors clustered at the bank level. The baseline regression model is set up as follows:

$$LLP_{i,t} = \alpha_1 + \beta_1 MPS_t + \Upsilon Bankcontrols_{i,t} + \Phi Macrocontrols_t + \mu_1 Timetrend_t + \upsilon_i + \varepsilon_{i,t} \quad (1)$$

where the independent variable *LLP* denotes banks' loan loss provisions; *MPS* denotes our main variable of interest, i.e. monetary policy shock, which is defined in detail in Section 3.3. We include bank-level controls (*Bankcontrols*) to account for bank characteristics associated with loan loss provisions, which includes bank size (*Size*), profits before tax and loan loss provisions (as a share of total assets, *EBTP*), growth rate of non-performing loans (*NPLgrowth*), growth rate of total loans (*Loangrowth*), capital adequacy ratio (*CAR*) and loan-to-asset ratio (*LTA*). We also control for macroeconomic conditions (*Macrocontrols*) using GDP growth rate (*GDPgrowth*), consumer price index (*CPI*), real estate climate index (*RECI*) and the ratio of government expenditure to GDP (*GovExp*). The detailed definition and explanation of these variables can be found in Section 3.3. The subscript *i* represents banks and *t* represents years. υ_i denotes bank fixed effects, which is used to control for bank-level observable and unobservable factors that are constant across the sample period. In addition, to control for other potential omitted variables that are related to time trend, we also include a time trend term (*Timetrend*) in the regression model. $\varepsilon_{i,t}$ is the error term. The coefficient on MPS_t, β_1, which is the main focus of our study, is predicted to be negative as explained in Section 2.

We control for potential endogeneity through the following approaches. First, we adjust the sample in several ways to demonstrate that the results are not driven by a specific sample selection. Meanwhile, we use the Heckman two-stage model to examine whether there is a severe sample selection bias in the benchmark regression. Second, to mitigate the influence of omitted variables, we control for additional bank-level and macro-level control variables, such as the ratio of non-performing loans to total loans, the ratio of general credit to GDP, and general credit growth. Third, considering that relying on any single indicator may erode the credibility of the results due to potential measurement errors, we employ alternative measures of LLPs and MPS to assess the robustness of our conclusions. Fourth, to mitigate the issue of reverse causality, we lag the explanatory and control variables by one period and re-estimate the model. Finally, we use instrumental variables to further overcome the potential endogeneity issues.

We also perform a series of other robustness checks, including conducting regressions using robust standard errors clustered at different levels and winsorizing the sample data at different levels. In addition, the two-step system GMM method is also employed as a robustness check.

3.2. Data

To estimate the model, we use panel data of 88 Chinese banks over the period of 2008–2022 due to data availability. China's financial system is bank-based and the banking industry is crucial for providing credit and promoting economic growth. Meanwhile, bank credit channel is the main channel of monetary policy transmission in China due to banks' dominant role in China's financial system. All these characteristics make the Chinese banks an ideal sample for analyzing the impact of MPS on bank LLPs.

Regarding the sources of the data, banks' financial data are collected from various sources including the Wind database, the BankScope database and the official websites of banks. Macroeconomic data are drawn from China Economic Net and the website of People's Bank of China (PBOC, China's central bank).

3.3. Variables

The definition and description of the variables are presented in Table 1. Table 2 reports the summary statistics of the variables.

As usual, the dependent variable, *LLP*, is the loan loss provisions scaled by total assets (e.g. Olszak et al., 2017). In the robustness tests, we also use the ratio of LLPs to total loans (*LLPTL*) and the natural logarithm of LLP (*lnLLP*) as alternative measures of banks' LLPs. According to the results in Table 2, the sample average of *LLP* is 1.56%.

We construct a measure of monetary policy shocks by examining high-frequency interest rate fluctuations within a narrow window around policy announcements. Conventional monetary policy indicators, such as M2 growth, are often highly endogenous, since policy decisions largely respond to current and expected macroeconomic conditions (Gertler and Karadi, 2015; Nakamura and Steinsson, 2018; Bujunoori et al., 2024). Chen et al. (2018) decompose M2 growth into endogenous and exogenous components: the endogenous part reflects anticipated policy shifts based on prevailing economic conditions, while the exogenous part captures unexpected shocks. Their findings show that endogenous monetary policy closely tracks actual M2 growth, meaning much of the observed variation in M2 growth can be explained by economic fundamentals. Because banks adjust their strategies in response to the broader macroeconomic environment, using actual M2 growth to proxy monetary policy when assessing banks' strategic behavior raises significant endogeneity concerns. Banks may alter their activities in light of both economic conditions and expected policy changes, making it challenging to isolate the true effect of monetary policy shifts.

Since financial market prices incorporate expectations, unexpected price movements following monetary policy announcements capture the exogenous component of monetary policy while remaining uncorrelated with its endogenous component (Tang et al., 2022). By using MPS in our analysis, we can isolate monetary policy shocks from general macroeconomic influences (Jiang et al., 2024), thereby improving the identification of causal effects associated with monetary policy on banks' strategic decisions.

The proxies for monetary policy shock (MPS) using high-frequency identification are in the spirit of the recent work by Nakamura and Steinsson (2018) and Tang et al. (2022). Nakamura and Steinsson (2018) use an entirely VAR-free approach to measure MPS in the

United States. They treat the changes of Fed funds futures rates during the short window period before and after the FOMC announcements as a proxy variable for monetary policy shock. Some studies use VAR method to calculate MPS (e.g., Gertler & Karadi, 2015; Kim & Lim, 2022). However, Nakamura and Steinsson (2018) argue that the VAR approach may not accurately describe the dynamic responses of key variables to MPS. Therefore, we construct the Chinese MPS indicator using the VAR-free approach in the spirit of Nakamura and Steinsson (2018) but tailor their approach to account for China's monetary policy practice. In particular, we calculate the Chinese MPS indicator as the changes in the 1-year interest rate swap of the 7-day fixing repo rate (FR007–IRS) before and after the monetary policy announcements from the PBOC. As there is no regular monetary policy meeting as well as announcement similar to that of FOMC, we focus on the monetary policy announcements made by the PBOC, including changes in both quantity-based (reserve requirement ratio) and price-based (benchmark interest rate) monetary policies. In contrast to Tang et al. (2022), who construct the Chinese MPS based on short-term FR007–IRS movements around the aforementioned two policies, we further take into account the PBOC's *China Monetary Policy Report*, which releases information on both the current monetary policy stance as well as the future direction of monetary policy adjustments. These three main tools used by the PBOC are disseminated through the PBOC's official website, government portals as well as various news outlets. In terms of influence and impact, they are comparable to the announcements made by the FOMC. Our definition of central bank's announcement in China is similar to that of Lu et al. (2023), who also construct China's MPS based on these three main tools. In addition, China does not have minute-frequency trading data similar to Fed funds futures rates. However, the IRS–FR007 trading in China is active and highly marketized, with its daily interest rate data disclosed, allowing us to observe its rapid response to MPS. Therefore, following Tang et al. (2022) and Das and Song (2023), we utilize the changes in IRS–FR007 during the trading days before and after the announcement disclosure as an indicator of China's MPS, and obtain the annual indicator of MPS by aggregating the daily data.

We conduct several tests to address identification concerns. First, we use an alternative measure of MPS in the robustness test in Section 4.2, which is constructed by Jiang et al. (2024) in the spirit of Taylor rule (Taylor, 1993). Second, following Jarociński and Karadi (2020), we identify and extract the central bank information shocks from the sample, which ensures that our estimation results only capture the changes in LLPs caused by unexpected monetary policy adjustments. Jarociński and Karadi (2020) suggest that central bank information shocks will also lead to fluctuations in interest rates during the announcement window and improve banks' expectations about future loan performance by conveying positive expectations about the future economy, which in turn lowers LLPs. Although this channel may also serve as an explanatory mechanism, it is not the focus of our analysis. Therefore, we attempt to identify whether our main conclusion still holds after excluding the impact of this channel. Furthermore, based on the approach proposed by Miranda-Agrippino and Ricco (2021), we also employ a multi-step regression to remove the historical information contained in the MPS indicator, as well as any predictive information that may be related to the current economic conditions. This further helps to identify the portion of unexpected monetary policy shocks. These discussions can be found in Sections 4 and 5.

We control for various bank-specific factors that are likely to affect LLPs. Bank size is proxied by the natural logarithm of total bank assets (*Size*). According to Dou et al. (2018), the growth of non-performing loans (*NPLgrowth*) represents existing loan quality, which can also be used to predict the direction of adjustments in LLPs based on its forward-looking nature (Beatty & Liao, 2014; Balla & Rose, 2015). As shown in Table 2, *NPLgrowth* in our sample has an average of 42.23%. The growth of loans and the asset structure can also affect the level of credit risk in banks and the extent to which banks are affected by credit risk (Caporale et al., 2018), so we control for the annual growth of total loans (*Loangrowth*) and the ratio of loans to assets (*LTA*). The capital adequacy ratio (*CAR*) and the ratio of profits before tax and loan loss provisions to total assets (*EBTP*) proxy for the discretionary components of LLPs, standing for banks' discretionary behavior of income smoothing or capital management (Kim et al., 2019; Ng et al., 2020; Danisman et al., 2021). Table 2 shows that *EBTP* has an average of 2.58% and *CAR* has an average of 13.23%.

In addition to controlling for factors at the bank level, we also control for macro-level factors. First, to control for economic growth, we include the real GDP growth rate (*GDPgrowth*) in the regression. According to Agénor and Zilberman (2015) and Ren et al. (2023), the procyclical nature of LLP may result in its contraction during periods of higher economic growth. Second, inflation and asset prices can cause credit risks and affect default rates, thus influencing LLPs, so we control for Consumer Price Index (*CPI*) and Real Estate Climate Index (*RECI*). Additionally, as fiscal policy (government spending) has a wide influence on economic and financial activities and thus may affect LLPs, we also include government expenditure to GDP (*GovExp*, as a proxy for fiscal policy) in the regression model.

Besides the controls mentioned above, additional potential controls are also included in the model as robustness checks. Detailed discussions will be presented in Section 4.2.

The correlations between variables are presented in Table 3, from which we can see that, all the correlation coefficients between explanatory variables are below 0.50, suggesting that multicollinearity is not of great concern in our study.

Table 1 Variable descriptions

Variable	Description
LLP	Loan loss provisions / total assets
MPS	Monetary policy shock
Size	The natural logarithm of total assets
EBTP	Profits before tax and loan loss provisions /total assets
NPLgrowth	The growth rate of non-performing loans
Loangrowth	The growth rate of total loans
CAR	Capital adequacy ratio
LTA	Total loans/ total assets
GDPgrowth	The growth rate of real GDP
CPI	Consumer Price Index

RECI	Real Estate Climate Index
GovExp	Government expenditure / GDP

Notes: This table summarizes the variable descriptions.

Table 2 Descriptive statistics

Variable	N	Mean	Min	Max	Std. Dev.
LLP	880	0.0156	0.0031	0.0527	0.0056
MPS	880	0.0092	-0.3200	0.2704	0.0884
Size	880	17.9432	14.6992	22.3233	1.4935
EBTP	880	0.0258	0.0097	0.0525	0.0062
NPLgrowth	880	0.4223	-0.8838	109.8929	3.7572
Loangrowth	880	0.1809	-0.3640	1.3579	0.1328
CAR	880	13.2281	4.3300	28.9400	1.7359
LTA	880	46.5618	15.8049	69.7312	9.6822
GDPgrowth	880	6.4973	2.2000	10.6000	2.1438
CPI	880	2.1650	-0.7000	5.9000	1.0066
RECI	880	99.0183	93.1291	104.3100	3.0026
GovExp	880	0.2357	0.1961	0.2553	0.0136

Notes: This table presents the descriptive statistics of our baseline regression variables, including the number of observations, mean, minimum, maximum and standard deviation of the variables.

Table 3 Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LLP	1											
MPS	-0.052	1										
Size	-0.132***	-0.020	1									
EBTP	0.734***	0.008	-0.100***	1								
NPLgrowth	-0.074**	-0.015	-0.032	-0.058*	1							
Loangrowth	-0.263***	0.010	-0.153***	-0.165***	0.228***	1						
CAR	0.110***	-0.004	0.027	0.247***	-0.013	-0.049	1					
LTA	0.549***	0.021	0.141***	0.449***	-0.109***	-0.187***	0.046	1				
GDPgrowth	-0.312***	0.228***	-0.051	-0.031	0.031	0.223***	-0.058*	-0.245***	1			
CPI	-0.139***	0.206***	-0.029	0.022	0.011	0.155***	0.114***	-0.066*	0.045	1		
RECI	0.080**	0.303***	-0.004	-0.037	-0.061*	0.217***	0.104***	0.094***	0.206***	0.232***	1	
GovExp	-0.157***	-0.273***	-0.075**	-0.084**	0.014	-0.061*	-0.118***	-0.363***	-0.148***	-0.060*	-0.088***	1

Notes: (1) This table shows the Pearson correlations between each pair of variables. (2) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4. Empirical results

4.1. Baseline results

Table 4 presents the baseline results, in which Columns 1–3 report the results obtained from fixed effects (FE), random effects (RE) and pooled ordinary least squares (POLS), respectively. In all regressions, we treat heteroscedasticity problems using robust standard errors clustering at the individual level.

Our focus is to examine whether MPS has a significant impact on LLPs. As one can see, the coefficients on MPS are negative and statistically significant in all regressions, suggesting that an increase in MPS would lead to a decrease in LLPs, which supports **H1**. Moreover, the impact of MPS on LLPs is also economically important. Taking the results in Table 4 for example, a one-standard deviation increase in MPS will cause a decrease in LLPs of 5.21% of its standard deviation.

With regard to the bank-level controls, *EBTP* has a significantly positive impact on LLP, implying that banks with higher profits tend to set aside more accruals in order to reduce fluctuations of reported earnings, which is consistent with the prior findings that banks use LLPs for income smoothing (e.g., Kanagaretnam et al., 2003; Ozili, 2019). The coefficients on *NPLgrowth* are significantly positive in Columns 1 and 3, indicating that banks with higher credit risk tend to keep higher LLPs for non-discretionary reasons, as documented in prior studies (Caporale et al., 2018; Ng. et al., 2020; Danisman et al., 2021). Turning to macro controls, Table 4 shows that an increase in GDP growth will lead to a significant decrease in LLPs, revealing that banks typically set aside less LLPs during good times, which is consistent with the procyclicality of LLPs as documented in Soedarmono et al. (2017).

Table 4 Baseline results

	Dependent variable: Loan loss provisions / assets (*LLP*)		
	Fixed Effects (1)	Random Effects (2)	POLS (3)
MPS	-0.0033^{***}	-0.0032^{***}	-0.0049^{***}
	(0.0009)	(0.0009)	(0.0010)
Size	0.0002	-0.0005^{***}	-0.0005^{***}
	(0.0011)	(0.0001)	(0.0001)
EBTP	0.6084^{***}	0.6104^{***}	0.6217^{***}
	(0.0628)	(0.0186)	(0.0535)
NPLgrowth	0.0000^{*}	0.0000	0.0000^{**}
	(0.0000)	(0.0000)	(0.0000)
Loangrowth	-0.0032^{***}	-0.0028^{***}	-0.0058^{***}
	(0.0006)	(0.0007)	(0.0010)
CAR	-0.0003^{**}	-0.0003^{***}	-0.0004^{***}
	(0.0001)	(0.0001)	(0.0001)
LTA	0.0001^{***}	0.0001^{***}	0.0000^{*}
	(0.0000)	(0.0000)	(0.0000)
GDPgrowth	-0.0002^{***}	-0.0002^{***}	-0.0008^{***}
	(0.0000)	(0.0001)	(0.0001)
CPI	-0.0003^{***}	-0.0003^{***}	-0.0009^{***}
	(0.0001)	(0.0001)	(0.0001)
RECI	0.0002^{***}	0.0002^{***}	0.0005^{***}
	(0.0000)	(0.0000)	(0.0000)
GovExp	-0.0171^{*}	-0.0176^{**}	-0.0641^{***}
	(0.0096)	(0.0073)	(0.0127)
Constant	-0.0272	-0.0133^{***}	-0.0125^{**}

	(0.0214)	(0.0040)	(0.0061)
Bank FE	Yes	No	No
Time Trend	Yes	Yes	No
Observations	879	880	880
Adjusted R^2	0.87	0.76	0.75

Notes: (1) This table presents estimation results for regressions of loan loss provisions (LLPs) on monetary policy shock (MPS) and controls, using fixed-effects, random-effects and POLS estimation methods. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *Size*: natural logarithm of total assets; *EBTP*: profits before tax and loan loss provisions scaled by total assets; *NPLgrowth*: the growth rate of non-performing loans; *Loangrowth*: the growth rate of total loans; *CAR*: capital adequacy ratio; *LTA*: total loans scaled by total loans; *GDPgrowth*: the growth rate of GDP; *CPI*: Consumer Price Index; *RECI*: Real Estate Climate Index; *GovExp*: government expenses divided by GDP. Bank fixed effect is controlled in Column (1), and time trend is controlled in Columns (2) and (3). (3) Robust standard errors, clustered at the bank level, are reported in parentheses. (4) The estimation period is 2008–2022. (5) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2. Robustness tests

To build more confidence into our baseline results, we conduct a variety of robustness tests to show that the results are not driven by sample selection bias, omitted variables, measurement errors, reverse causality and other potential endogeneity problems.

4.2.1 Subsample regressions

To demonstrate that the baseline results are not obtained due to a specific sample selection, we adjust the sample used in the regressions by including different time periods and using different bank types.

First, to eliminate the potential impact of the 2008 global financial crisis, Column 1 of Table 5 shows the estimation results of the baseline model without including data of 2008. Similarly, considering that the COVID–19 pandemic that broke out in 2020 had a sustained and significant impact on the Chinese economy, which may cause changes in bank behavior, we also exclude data after 2020 and re-estimate the regression. The results are reported in Column 2 of Table 5. Column 3 reports the results for excluding both data for 2008 and data after 2020. The estimated coefficients of MPS on LLPs in Columns 1–3 are all significantly negative, which is consistent with the baseline results, indicating that the main conclusion of our study remains valid after excluding the influence of significant events that happened during the sample period.

To see whether the baseline results hold for different types of banks, we split our sample into two categories based on bank equity ownership structure: (i) large commercial banks and joint-stock banks, and (ii) local commercial banks. In China, large commercial banks and joint-stock banks typically have nation-wide branches and can do business across the country, while local commercial banks mainly concentrate their business activities on the local economy. So, these two types of banks may exhibit different preferences and behaviors. As shown in Columns 4–5 in Table 5, the coefficients on MPS are significantly negative in both groups, which suggests that the baseline results are not limited to any particular type of bank.

To further examine whether the impact of MPS on LLPs differs between large and local banks, we introduce a dummy variable for local commercial banks (LCB) in our baseline regression and interact it with other relevant variables.

In Column 6 of Table 5, we include the interaction term between LCB and MPS. The coefficient of this interaction is statistically insignificant, indicating no substantial difference in the influence of MPS on LLPs between large and local banks.

Additionally, we extend this analysis by interacting LCB with all bank-specific and macroeconomic control variables. As shown in Column 7 of Table 5, the interaction term (MPS × LCB) remains statistically insignificant, reaffirming that the effect of MPS on LLPs does not differ significantly between the two types of banks.

Table 5 Subsample analysis

	Dependent variable: Loan loss provisions / assets (*LLP*)						
	Data of 2008 excluded	Data of 2020–2022 excluded	Data of 2009–2019	Large state-owned banks and joint-stock banks	Local commercial banks	Diff. between LCBs and non-LOBs	Diff. between LCBs and non-LOBs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MPS	-0.0024^{**}	-0.0040^{***}	-0.0024^{**}	-0.0035^{**}	-0.0020^{*}	-0.0042^{***}	-0.0018
	(0.0011)	(0.0010)	(0.0012)	(0.0011)	(0.0011)	(0.0011)	(0.0028)
MPS × *LCB*						0.0011	0.0007
						(0.0014)	(0.0016)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls × *LCB*	NO	NO	NO	NO	NO	NO	Yes
Macro controls × *LCB*	NO	NO	NO	NO	NO	NO	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	870	626	617	133	746	879	879
Adjusted R^2	0.87	0.83	0.83	0.93	0.86	0.87	0.87

Notes: (1) This table presents estimation results for regressions of loan loss provisions (LLPs) on monetary policy shock (MPS) in different subsamples, using fixed-effects estimation with robust standard errors clustered at bank level. Column 1 presents the estimation results excluding the data from 2008 to mitigate the bias caused by the financial crisis. Column 2 presents the regression results excluding the data from 2020–2022 to mitigate the bias caused by the COVID-19 pandemic. Column 3 presents the regression results using data from 2009–2019. Column 4 is the estimation results for large state-owned banks and joint-stock banks, and Column 5 is the estimation results for local commercial banks. Columns 6–7 introduce interaction terms to examine the differential impacts of MPS between large banks and local banks. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *LCB*: a dummy variable indicating local commercial banks. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI, RECI and GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period for Column 1 is 2009–2022, the estimation period for Column 2 is 2008–2019, the estimation period for Column 3 is 2009–2019, and the estimation period for Columns 4–7 is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2.2 Heckman two-stage estimation

In our collected sample, some banks did not disclose the data of LLPs, which resulted in the exclusion of these banks' data from the regression analysis. This could potentially introduce bias into the results. To address this issue, we use the Heckman two-stage model to re-estimate the regression.

Specifically, we introduced a dummy variable, *IFLLP*, which is set to 1 if bank *i* discloses data of LLPs in year *t*. We regress this dummy variable on the control variables from the baseline model and the bank's equity capital ratio. A higher equity capital ratio indicates greater shareholder influence, in which case the shareholders are induced to better monitor and supervise banks in disclosing LLPs. However, this indicator does not directly impact banks' decision to adjust LLPs, making it an exogenous control variable in the first stage.

The results of the first-stage regression are shown in Column 1 of Table 6. We include the Inverse Mills Ratio (*IMR*) calculated from the first-stage model in the benchmark regression, creating the second-stage model for estimation. As shown in Column 2 of Table 6, the coefficient of *MPS* remains significantly negative, indicating that the baseline results remain valid. Furthermore, the IMR coefficient is not significant, suggesting that the design of the baseline regression does not suffer from severe sample selection bias.[1]

Table 6 Heckman two-stage estimation

	Heckman two-stage model		Fixed effect model	
	Dependent variable: *IFLLP*	Dependent variable: Loan loss provisions / assets (*LLP*)	Dependent variable: Loan loss provisions / assets (*LLP*)	
	(1)	(2)	(3)	(4)
MPS	-1.7640***	-0.0028**	-0.0026**	-0.0033***
	(0.6133)	(0.0014)	(0.0012)	(0.0009)
Size	0.7590***	0.0004	0.0004	0.0002
	(0.2007)	(0.0017)	(0.0016)	(0.0011)
EBTP				0.6084***
				(0.0628)
NPLgrowth	0.0414	0.0000	0.0000	0.0000*
	(0.0780)	(0.0000)	(0.0000)	(0.0000)
Loangrowth	-1.1396	-0.0052***	-0.0050***	-0.0032***
	(0.8175)	(0.0014)	(0.0012)	(0.0006)
CAR	-0.1610*	-0.0001	-0.0001	-0.0003**
	(0.0867)	(0.0001)	(0.0001)	(0.0001)
LTA	-0.0547***	0.0003***	0.0003***	0.0001***
	(0.0187)	(0.0000)	(0.0000)	(0.0000)
GDPgrowth	-0.1059*	0.0001	0.0001	-0.0002***
	(0.0553)	(0.0001)	(0.0001)	(0.0000)
CPI	-0.0296	0.0000	0.0000	-0.0003***
	(0.0886)	(0.0001)	(0.0001)	(0.0001)
RECI	0.1157**	0.0001	0.0001	0.0002***
	(0.0485)	(0.0001)	(0.0001)	(0.0000)
GovExp	-15.4699	0.0109	0.0119	-0.0171*
	(18.1005)	(0.0163)	(0.0159)	(0.0096)
EA	0.2554*			
	(0.1389)			
IMR		0.0011		

[1] Due to the same frequency of missing values in the control variable *EBTP* and the dependent variable *LLP*, we did not include *EBTP* in the Heckman two-stage model. Columns 3 and 4 in Table 6 show the regression results of the baseline model with and without *EBTP* to demonstrate that excluding *EBTP* from the control variables does not result in a non-significant effect of MPS on LLPs.

		(0.0033)		
Bank FE	No	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Observations	906	879	879	879
Adjusted R^2 (Pseudo R^2 in Column(1))	0.35	0.70	0.70	0.87

Notes: (1) This table presents estimation results for Heckman two-stage model. Column 1 presents the estimation results of the first stage model. Column 2 presents the estimation result of the second stage model. Due to the same frequency of missing values in the control variable *EBTP* and the dependent variable *LLP*, *EBTP* is not included in the Heckman two-stage model. Columns 3 and 4 present the regression results of the baseline model with and without *EBTP* to demonstrate that excluding *EBTP* from the control variables does not result in a non-significant effect of *MPS* on *LLP*. (2) Dependent variables: *IFLLP*: dummy variable (0-the bank does not disclose LLP data; 1- the bank does disclose LLP data); *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *EA*: the ratio of equity to assets; *IMR*: Inverse Mills Ratio. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in Heckman 2nd stage model and Columns (3) and (4). (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2.3 Including additional controls

To mitigate the issue of omitted variables, we control for additional bank-level and macro-level controls that may affect LLPs. We do not include these variables in our baseline regressions due to poorer data coverage.

Specifically, according to Kim et al. (2019), net charge-off divided by lagged total loans (*NCOAL*) is considered to be a factor determining the disciplinary component of LLPs. Besides, the net interest margin (*NeIIAA,* calculated as net interest income to average total assets) could be used to capture banks' exercise of discretion over LLPs to smooth income (Dou et al., 2018). Some previous studies (e.g., Danisman et al., 2021) suggest that non-performing loans ratio (*NPLTL*, calculated as non-performing loans to total loans) is also an important factor affecting banks' non-discretionary LLPs. In addition, we also take into account the impact of macro credit conditions on bank LLPs by controlling for the growth rate of aggregate loans (*Creditgrowth*) as well as the aggregate loans to GDP ratio (*CreditGDP).*

The results with the above additional controls are presented in Table 7, from which we can see that all the coefficients for *MPS* remain significantly negative, which further confirms our baseline results.

Table 7 Including additional controls

	Dependent variable: Loan loss provisions / assets (*LLP*)				
	(1)	(2)	(3)	(4)	(5)
MPS	-0.0028***	-0.0029***	-0.0019*	-0.0019*	-0.0018*
	(0.0009)	(0.0010)	(0.0011)	(0.0011)	(0.0011)
NCOL	0.0009***	0.0009***	0.0006**	0.0007**	0.0006**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
NeIIAA		-0.0013***	-0.0011***	-0.0011***	-0.0011***
		(0.0004)	(0.0003)	(0.0003)	(0.0003)

NPLTL			0.1060***	0.1059***	0.1082***
			(0.0354)	(0.0341)	(0.0338)
Creditgrowth				0.0211***	0.0156***
				(0.0052)	(0.0052)
CreditGDP					0.0077***
					(0.0024)
Bank controls	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes
Observations	825	825	825	825	825
Adjusted R^2	0.89	0.89	0.91	0.92	0.92

Notes: (1) This table presents estimation results for regressions of loan loss provisions (LLPs) on monetary policy shock (MPS), using fixed-effects estimation with robust standard errors clustered at bank level. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *NCOAL*: net charge-off divided by lagged total loans; *NeIIAA*: net interest income scaled by average total assets; *NPLTL*: the ratio of the non-performing loans to total loans; C*reditgrowth*: the growth rate of general credit; *CreditGDP*: the ratio of general credit to GDP. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on Controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2.4 Alternative measures of LLPs and MPS

To address potential measurement errors associated with our main variables of interest, we also test the robustness of our results using different measures of LLPs and MPS. First, we adopted the natural logarithm of LLP (l*nLLP*) and the ratio of LLPs to loans (*LLPTL*) as alternative measures of LLPs, as in Beatty and Liao (2014). Then, we replace *MPS* with *MPS2*, which is calculated using the regime-switching Taylor rule-style approach in Jiang et al. (2024). The use of Taylor rule residual as a monetary policy shock is also in line with the standard theory of macroeconomics (e.g., Bernanke et al., 1999; Smets & Wouters, 2003, 2007). The estimation results are reported in Table 8, from which we can see that the baseline results again remain valid.

Table 8 Alternative measures of LLPs and MPS

	Dependent variable: *lnLLP*	Dependent variable: Loan loss provisions / loans (*LLPTL*)	Dependent variable: Loan loss provisions / assets (*LLP*)
	Alternative measure of LLP: *lnLLP*	Alternative measure of LLP: *LLPTL*	Alternative measure of MPS: Jiang et al. (2024)
	(1)	(2)	(3)
MPS	-0.2941***	-0.0070***	
	(0.0680)	(0.0018)	
MPS2			-0.0015*

			(0.0009)
Bank controls	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes
Observations	879	879	712
Adjusted R^2	0.87	0.77	0.84

Notes: (1) This table presents estimation results using alternative measures of LLPs and MPS, estimated with fixed-effect model with robust standard errors clustered at bank level. (2) Dependent variables: *lnLLP*: the natural logarithm of loan loss provision (Column 1); *LLPTL*: total loan loss provisions scaled by total loans (Column 2); *LLP*: total loan loss provisions scaled by total assets (Column 3). Independent variables: *MPS*: monetary policy shock using high-frequency identification (Columns 1–2); *MPS2*: monetary policy shock from Jiang et al. (2024) (Column 3). Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2.5 2SLS-IV estimation

To further account for endogeneity problems caused by unobservable omitted variables and reverse causality, we employ the two-step least-squares (2SLS) Instrumental Variable (IV) approach to estimate the model. The IV regression results are shown in Table 9.

We use two instrumental variables (IVs) in our analysis: the release time of the People's Bank of China's (PBOC) *China Monetary Policy Report* (MPR) and the release time of the PBOC's Report on Regional Financial Operations (RFOR) for the previous year. The first- and second-stage regression results are presented in Columns 1 and 2 of Table 9, respectively.

We argue that these IVs are valid for the following reasons. Regarding their relevance, the release time of the previous year's MPR reflects the economic environment and the central bank's response to it. A delayed release of the MPR may indicate a challenging economic situation, which necessitates a more cautious and nuanced approach in the report's language, balancing objective analysis with positive signaling. Additionally, during periods of economic downturn, monetary authorities often face increased workloads, further suggesting that expansionary monetary policy shocks are more likely in the current year. Our first-stage 2SLS regression result in Column 1 of Table 9 supports this hypothesis, showing a significant negative coefficient between MPR and MPS.

The RFOR, which summarizes local financial conditions and reports potential financial risks, is the second IV. A delay in the release of the RFOR may signal either substantial financial accomplishments or increased risk-taking, both of which typically require more time to report. In both cases, these conditions suggest a need for contractionary monetary policy to curb overheating and excessive risk-taking. Consequently, we expect a delayed release of the previous year's RFOR to be associated with a higher probability of contractionary monetary policy in the current year. The first-stage result from our 2SLS regression shows a significantly positive coefficient for RFOR on MPS at the 1% level, providing strong evidence for the relevance of this IV.

Regarding exogeneity, as shown in Column 2 of Table 9, the *p*-value of the Hansen-*J* test is 0.59, which fails to reject the null hypothesis of overidentification, thus supporting the exogeneity of all instrumental variables. Intuitively, it is unlikely that banks adjust their

LLPs based on the release time of the central bank's reports, suggesting that these IVs do not directly affect the dependent variable. Furthermore, we considered the possibility that these IVs might indirectly influence LLPs through their impact on the incidence of bank loan defaults. To investigate this, we empirically tested the effects of MPR and RFOR on NPLTL and lnNPL, with the results provided in Table A1 in the Appendix. The regression results indicate that these two variables do not significantly affect the incidence of bank loan defaults. Thus, these findings collectively support the conclusion that the IVs satisfy the exclusion restriction condition, confirming their validity in our analysis.

Meanwhile, as in Wang et al. (2014), we also use U.S. and global economic policy uncertainty indexes as additional IVs for MPS. The "economic policy uncertainty (EPU) index" is constructed by Baker et al. (2016), which are based on the number of news articles including certain terms related to economic policy uncertainty published by each newspaper in various countries. This index is widely used in the previous studies to measure policy uncertainty (e.g., Ng. et al., 2020; Danisman et al., 2021; Berger et al., 2022). According to Wang et al. (2014), U.S. and global economic policy uncertainty indexes have a close relationship with China's MPS and influences LLPs only through the main independent variable *MPS*, making the linear combination of the two indexes a suitable instrumental variable. The results using this IV are reported in Columns 3 and 4 of Table 9. In addition, we also use the lagged independent variable (*L.MPS*) as an alternative instrumental variable, with the results reported in Columns 5–6 of Table 9.

From the results in Table 9, we can see that our main conclusion, i.e., MPS has a negative impact on LLPs, is still valid in all regressions. This means that our main conclusion remains robust after addressing potential endogeneity problems using 2SLS–IV estimation. Specifically, in all first-stage regressions, the instrumental variable has a significant impact on MPS. In all second-stage regressions, the *p*-values of the Kleibergen-Paap rk LM test (UnderIden–Chi(1)) are less than 0.1, rejecting the null hypothesis of underidentification test. The Kleibergen-Paap rk Wald F statistics are much larger than the 10% critical value, indicating a rejection of the hypothesis of weak instrumental variables. All these indicators suggest that the choice of instrumental variable is suitable and our 2SLS–IV estimation results are valid.

Table 9 2SLS-IV estimation

	IV: MPR & RFOR		IV: EPU		IV: lagged MPS	
	(1)	(2)	(3)	(4)	(5)	(6)
	MPS	LLP	MPS	LLP	MPS	LLP
MPS		-0.0079***		-0.0086**		-0.0067***
		(0.0022)		(0.0034)		(0.0017)
L.MPR	-0.0002***					
	(0.0000)					
L.RFOR	0.0004***					
	(0.0000)					
usepu			-0.0000***			
			(0.0000)			

gepu			-0.0001***			
			(0.0000)			
L.MPS					-0.4540***	
					(0.0126)	
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
UnderIden-Chi(1) P value		0.00		0.00		0.00
Hansen-J P value		0.59		0.73		
Kleibergen-Paap rk Wald F statistic		121.48		44.88		1294.80
Observations	879	879	879	879	870	870
Adjusted R^2		0.75		0.75		0.76

Notes: (1) This table presents estimation results using the two-step least-squares (2SLS) Instrumental Variable (IV) approach. (2) Dependent variables: *LLP*: total loan loss provisions scaled by total assets (Columns 2, 4, 6); *MPS*: monetary policy shock using high-frequency identification (Columns 1, 3, 5). Independent variables: *L.MPR*: the release time of the PBOC's China Monetary Policy Report for the previous year; *L.RFOR*: the release time of the PBOC's Report on Regional Financial Operations for the previous year (Column 1); *MPS*: monetary policy shock using high-frequency identification (Columns 2, 4, 6); *usepu*: the Economic Policy Uncertainty Index of United States (Column 3); *gepu*: the average Economic Policy Uncertainty Index of the world (Column 3); *L.MPS*: lagged MPS (Column 5). Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on Controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

4.2.6 Other robustness tests

To further verify the validity of the baseline results, we also perform a variety of additional robustness checks, as reported in Table 10.

One alternative explanation for our results is that the monetary authority may adjust monetary policy based on the signals of adjustments in LLPs from banks. Although we have attempted to mitigate this issue in the baseline regression by constructing an exogenous MPS indicator that does not include the economic signals, it only partially addresses the problem. In this section, we further address this issue by re-estimating the model with *MPS* and control variables lagged by one period. The results are reported in Column 1 of Table 10.

In addition, since robust standard errors are clustered at the bank level in the previous analysis, we also re-estimate the model with robust standard errors clustered at the year level in Column 2 (Nguyen & Phan, 2017) and at the bank and year level in Column 3 of Table 10 (Berger et al., 2022).

To exclude the influence of outliers, we also winsorize the data at the 1% and at the 5% levels in Columns 4 and 5 of Table 10, respectively.

Finally, as in Danisman et al. (2021), we also include lagged *LLP* in in the regression to account for the persistence behavior of banks' LLPs and use the two-step system GMM method to estimate the model. The results are reported in Column 6 of Table 10.

From the results in Table 10, we can see that the coefficients of *MPS* on *LLP* remain significantly negative in all regressions, which further confirms our main conclusion that banks will reduce LLPs when faced with greater MPS.

Table 10 Additional robustness tests

	Dependent variable: Loan loss provisions / assets (*LLP*)					
	Lagged MPS & all control variables	Robust s.e. clustered at a year level	Robust s.e. clustered at the bank and year level	All variables are winsorized at 1% level	All variables are winsorized at 5% level	GMM
	(1)	(2)	(3)	(4)	(5)	(6)
MPS		-0.0033***	-0.0033***	-0.0032***	-0.0033***	-0.0022**
		(0.0008)	(0.0006)	(0.0009)	(0.0008)	(0.0009)
L.MPS	-0.0023***					
	(0.0008)					
L.LLP						0.1991***
						(0.0406)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Hansen test P value						0.6405
AR(1) P value						0.0260
AR(2) P value						0.1013
Observations	791	879	879	879	879	871
Adjust R^2	0.74	0.87	0.87	0.87	0.87	-

Notes: (1) This table reports the results of robustness tests using fixed-effects model with robust standard errors clustered at year level (Column 2), robust errors computed on double cluster (bank and year, column 3) and robust standard errors clustered at bank level (Columns 1, 4–5). Column 6 shows the result obtained by adding the lagged LLP to the baseline regression model and re-estimating the model with the two-step system GMM approach. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock (Columns 2–6); *L.MPS*: lagged MPS (Column 1); *L.LLP*: lagged LLP (Column 6). Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. All the control variables are lagged by one period in Column 1. Variables in Columns 4 and 5 are winsorized at 1% and 5% level, respectively. (3) Coefficients on controls are omitted for brevity. (4) The estimation period is 2008–2022. (5) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

5. Mechanism tests

The previous analysis has confirmed a robust result that banks will reduce LLPs when MPS increases. In this section, we proceed to test the associated mechanisms as given by **H2** and **H3** in Section 2.

5.1 The impact of MPS on bank performance

To test **H2**, we use the natural logarithm of non-performing loans (*lnNPL*) and the ratio of non-performing loans to total loans (*NPLTL*) as the indicators of banks' loan performance, and use the natural logarithm of profit before tax (*lnPBT*) and the ratio of profit before tax to total assets (*PBTTA*) as the indicators of bank earnings. Other variables are the same as they are defined in the baseline regression. Note that, to test **H2** we lag MPS by one period. This is because, the main function of LLPs is to reserve funds to mitigate the risks of future non-performing loans, which means that we should anticipate a deterioration of banks' loan performance and profitability in the next period rather than the current period. In addition, as explained in Section 2, bank managers may have the incentive to adjust LLPs to conceal poor financial conditions. In this case, the current financial performance may also have been manipulated, which can lead to less non-performing loans and higher profitability in the current period. Taken together, if we find an increase in non-performing loans and a decrease in profitability in the next period as MPS increases, it can provide strong support for the conclusion that bank's motivation for lowering current LLPs is to beautify the financial statements, because this suggests that the bank's lowering of LLPs is not due to a decrease in loan risk in the next period, but rather a downward adjustment of LLPs to improve the current financial statements.

From the results in Table 11 we can see that, an increase in MPS leads to an increase in banks' *lnNPL* and *NPLTL*, as well as a decline in banks' *lnPBT* and *PBTTA*, which is in line with **H2**. These results underscore the argument that in the context of unexpected tightening of monetary policy, banks reduce LLPs not in response to improvements in loans and profitability. On the contrary, the unexpected tightening of MPS leads to a deterioration in loans and profitability. In this case, if banks proceed to lower LLPs, it is more likely attributed to the optimization of financial performance and the intention to convey positive signals.

Table 11 Mechanism test: bank loan performance and profitability

	Dependent variable: lnNPL (1)	Dependent variable: NPLTL (2)	Dependent variable: lnPBT (3)	Dependent variable: PBTTA (4)
L.MPS	0.4288***	0.0069**	-0.5867***	-0.0030***
	(0.1418)	(0.0032)	(0.1567)	(0.0008)
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Observations	870	870	868	870
Adjusted R^2	0.96	0.44	0.95	0.78

Notes: (1) This table presents the impact of MPS on bank loan performance and profitability, using fixed-effects estimation with robust standard errors clustered at bank level. (2) Dependent variables: *lnNPL*: the natural logarithm of non-performing loans; *NPLTL*: the ratio of the non-performing loans to total loans; *lnPBT*: the natural logarithm of profit before tax; *PBTTA*: the ratio of the profit before tax to total assets. Independent variable *L.MPS*: lagged monetary policy shock. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI, RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

5.2 The moderating effects of bank risk and resilience

To test **H3**, we divide banks into two sub-groups according to the loan-to-asset ratio (*LTA*) and provision coverage ratio (*Cov*) of each bank. In particular, if a bank has a higher proportion of loans, the impact of deteriorating loan performance caused by MPS will be greater, and then the bank will have to adjust LLPs to a greater extent. As for the provision coverage ratio, it serves as a proxy variable for the bank's risk resilience. If the bank has a higher provision coverage ratio, it is better equipped to withstand risks resulting from monetary policy shocks, and therefore, the bank's adjustments of LLPs would be smaller.

For the purpose of empirical test, first we generate two dummy variables for the sub-group of highest LTA (*LTAhigh*) and lowest Cov (*Covlow*). Then we add these two dummies as well as their interactions with *MPS* into the regression model. The results in Table 12 show that the coefficients for both interaction terms (*LTAhigh*MPS* and *Covlow*MPS*) are significantly negative. This implies that for banks with higher LTA and lower provision coverage ratio, an increase in MPS will lead to a larger decrease in LLPs.

In addition, we also examine the moderating effect of the bank's risk level on the relationship between MPS and LLPs by using the logarithm of non-performing loans (*lnNPL*) and the ratio of non-performing loans (*NPLTL*) as proxy variables for bank risk. In a similar fashion, these two dummies as well as their interactions with *MPS* are included in the regression. From the results in Table 12, we can see that the coefficients on the interaction term *MPS*lnNPL* are significantly negative, while those on the interaction term *MPS*NPLTL* are negative but not significant. This implies that for banks with higher risk, an increase in MPS would lead to a larger decrease in LLPs, which supports **H3.**

Overall, these results on the one hand confirm the "income smoothing hypothesis" that banks tend to reduce LLPs to compensate for their low earnings. On the other hand, these results are highly consistent with the "signaling hypothesis" that an increase in LLPs could convey bad news about loan default, which induces banks to reduce LLPs and to conceal negative information from bank outsiders. Considering that a tightening MPS has a negative impact on economic and financial activities and thus increases banks' credit risk, bank managers tend to hide bad news by reducing LLPs. Also, bank managers can improve their reported earnings by managing LLPs so as to avoid the negative impacts associated with low earnings report.

Table 12 Mechanism test: bank risk and risk resilience

	Dependent variable: Loan loss provisions / assets (*LLP*)			
	(1)	(2)	(3)	(4)
MPS	-0.0017	-0.0021^{*}	-0.0035^{***}	-0.0020^{**}
	(0.0013)	(0.0012)	(0.0009)	(0.0009)
LTAhigh	-0.0004			
	(0.0004)			
*LTAhigh*MPS*	-0.0033^{*}			
	(0.0020)			
Covlow		-0.0002		
		(0.0003)		
*Covlow*MPS*		-0.0024^{*}		

		(0.0013)		
lnNPL			0.0020***	
			(0.0006)	
*MPS*lnNPL*			-0.0045***	
			(0.0012)	
NPLTL				0.1118***
				(0.0293)
*MPS*NPLTL*				-0.3019
				(0.2600)
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Observations	879	879	879	879
Adjusted R^2	0.87	0.87	0.88	0.89

Notes: (1) This table presents the moderating effects of bank risk and risk resilience, using fixed-effects estimation with robust standard errors clustered at bank level. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *LTAhigh*: dummy variable(1-Bank i's LTA in year t is higher than the median LTA of all banks in that year；0-otherwise); *Covlow*: dummy variable(1-Bank i's provision coverage ratio in year t is lower than the median provision coverage ratio of all banks in that year；0-otherwise); *lnNPL*: the natural logarithm of non-performing loans; *NPLTL*: the ratio of the non-performing loan to total loan; *MPS*LTAhigh:* interaction between *MPS* and *LTAhigh*; *MPS*Covlow*: interaction between *MPS* and *Covlow; MPS*lnNPL:* interaction between *MPS* and *lnNPL*; *MPS*NPLTL*: interaction between *MPS* and *NPLTL*. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at bank level, are reported in parentheses. (5) The estimation period is 2008–2022. *, ** and *** represent significance at 10%, 5% and 1%, respectively.

5.3 Eliminating the impact of information effect

One concern about our analysis is that interest rate changes resulting from monetary policy announcements may not only reflect monetary policy shocks but also transmit new information released by the central bank. The information can potentially improve people's expectations about future economic prospects, leading to an increase in asset values, known as the "information effect" (Jarociński & Karadi, 2020). To address this concern, we construct two alternative measures of MPS that exclude the information effect and re-estimate the regressions.

First, as pointed by Jarociński and Karadi (2020), the interest rate movements towards the central bank announcements may reflect both the monetary policy shock and the central bank information shock. If the stock price movements around the announcement is in the same direction as the interest rates do, the shock can be recognized as the information shock. Following this approach, we exclude the announcements that caused interest rates and stock prices to move in the same direction, and recalculate the interest rate price changes caused by the remaining announcements to obtain a new indicator of MPS (denoted as *MPS_exp*). Then we re-estimate the baseline regression using *MPS_exp* with FE, RE and POLS methods. The results are reported in Columns 1–3 in Table 13.

In addition, we also follow Miranda-Agrippino and Ricco (2021) by constructing another measure of MPS that excludes the information effect. Miranda-Agrippino and Ricco (2021) suggest that the interest rate differences before and after central bank announcements reflect both monetary policy shocks and anticipated interest rate changes based on real economic information, which leads to its predictability and autocorrelation. Therefore, to capture the unexpected monetary policy shocks, it is necessary to exclude the information from real economic indicators and the information from the previous period. We achieve this objective by conducting stepwise regressions and taking the residuals. Specifically, we perform an autoregression of the MPS measure on its lagged values for one to three periods first. The residuals can be considered as the portion that does not include historical information. Then, we regress the obtained residuals on economic variables[2] to eliminate predictions based on current economic information. Finally, we use the residuals from the second regression as the MPS measure excluding the information effect (denoted as *MPS_exp2*). The estimation results with FE, RE and POLS estimation methods are reported in Columns 4–6 in Table 13.

Table 13 Eliminating the impact of information effect

	Dependent variable: Loan loss provisions / assets (*LLP*)					
	MPS identificated following Jarociński and Karadi (2020)			MPS identificated following Miranda-Agrippino and Ricco (2021)		
	Fixed Effects	Random Effects	POLS	Fixed Effects	Random Effects	POLS
	(1)	(2)	(3)	(4)	(5)	(6)
MPS_exp	-0.0061***	-0.0062***	-0.0077***			
	(0.0016)	(0.0016)	(0.0020)			
MPS_exp2				-0.0051***	-0.0053***	-0.0019
				(0.0015)	(0.0019)	(0.0018)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	No	No	Yes	No	No
Time Trend	Yes	Yes	No	Yes	Yes	No
Observations	879	880	880	834	835	835
Adjusted R^2	0.87	0.76	[illegible]	0.87	0.76	0.74

Notes: (1) This table presents the impact of MPS on LLPs after excluding the information effect. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS_exp*: MPS identificated following Jarociński and Karadi (2020); *MPS_exp2*: MPS identificated following Miranda-Agrippino and Ricco (2021). Bank controls include *Size, EBTP, NPL, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect is controlled in FE models, and time trend is controlled in FE models and RE models. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in

[2] The current economic variables conclude the growth of GDP (*GDPgrowth*), the Consumer Price Index (*CPI*), the ratio of general credit to GDP (*CreditGDP*), the ratio of government expenses to GDP (*GovExp*), the unemployment rate (*unemploy*), the Bank Climate Index (*BCI*) constructed by People's Bank of China, the Real Estate Climate Index (*RECI*) constructed by National Bureau of Statistics of China.

parentheses. (5) The estimation period is 2008-2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

From the results in Table 13, we can see that the coefficients for both of the two alternative measures of MPS (i.e., *MPS_exp* and *MPS_exps*) are estimated to be significantly negative, which suggests that our main conclusion still holds after addressing the potential information effect.

6. Further discussions

6.1 The impact of macroprudential regulation

An interesting issue relating to our study is how the impact of MPS on LLPs may vary with the implementation of macroprudential regulation. This issue is important in recent years because both monetary and macroprudential policies are widely used in major countries and the interactions between these two policies have been a main concern for both economists and policymakers. In this section, we proceed to discuss whether macroprudential regulation can effectively mitigate banks' behavior of lowering LLPs to beautify their financial statements.

To examine the moderating effect of macroprudential regulation on the MPS–LLPs nexus, we use the macroprudential policy index (*MPP*) constructed by the IMF (Cerutti et al., 2017) and the regulation quality index (*RQ*) constructed by the World Bank. We use these two indexes as proxies for macroprudential regulation and include them as well as their interactions with *MPS* in the baseline regression. The estimation results are shown in Columns 1–2 of Table 14, from which we can see that the coefficients on the interaction terms are significantly positive, indicating that stricter macroprudential regulation or higher regulatory quality can effectively reduce the extent to which banks lower their LLPs when facing a positive MPS. Essentially, this result can be interpretated as an agency problem arising from the information asymmetry between banks, shareholders and depositors (Bushman & Williams, 2015). This implies that adequate and rigorous regulation can enhance transparency in banks, which contributes to the improvement of banks' risk management and ensures the accurate transmission of information to clients. Note that our baseline results suggest that banks lower their LLPs to beautify their financial statements when faced with unexpected tightening monetary policy shocks. This not only reflects the abuse of discretionary powers by bank managers but also affects the smooth transmission of monetary policy. However, the moderating effect of macroprudential regulation on the MPS–LLPs nexus suggests that policymakers can alleviate this problem by enhancing macroprudential regulation.

6.2 The impact of credit contraction

Another interesting issue worthy of discussing is how the impact of MPS on banks' provisioning behavior may be influenced by credit contraction. On the one hand, banks' procyclical behavior will induce banks to reduce LLPs during periods of credit contraction to cover up declining profits and rising non-performing loans. On the other hand, reducing LLPs in periods of credit contraction makes banks especially vulnerable to exogenous shocks, increasing its insolvency risk. Meanwhile, lower LLPs during downturns may also catch regulators' attention, which induces more regulatory burdens due to stricter supervision. Therefore, banks will be more cautious in lowering LLP during periods of credit contraction. This also serves as an indirect argument to the influence of regulation on the MPS–LLPs nexus.

To investigate how the impact of MPS on banks' provisioning behavior may be influenced by credit contraction, first we use the gap value of credit to GDP (which is calculated as the deviation of credit/GDP from its trend value using HP filter) and the gap value of credit growth (which is calculated as the deviation of credit growth from its trend value using HP filter) to measure credit cycle. Then we generate two dummy variables to indicate credit contraction, i.e., *Creditgrowth_DC* and *CreditGDP_DC*. Specifically, if the credit growth in period *t* is lower than the trend value, *Creditgrowth_DC* is set to 1, indicating that credit expansion is in a downward cycle. Similarly, *CreditGDP_DC* is set to 1 when the credit-to-GDP ratio is below its trend value. By including these dummies as well as their interactions with *MPS* in the regression model, we obtain the results in Columns 3–4 of Table 14, from which we can see that the coefficients on the interaction term between *MPS* and *Creditgrowth_DC* (*MPS*Creditgrowth_DC*) and that between *MPS* and *CreditGDP_DC* (*MPS*CreditGDP_DC*) are significantly positive. These results suggest that the negative impact of MPS on LLPs is alleviated during periods of credit contraction. This is because, banks' behavior of reducing LLPs would be more risky during a credit downturn, no matter in the sense of maintaining their own anti-risk ability or satisfying regulatory requirements (regulators will be more sensitive to the behavior of lowering LLPs during credit downturns for prudential purposes). In this case, even if banks intend to lower LLPs to beautify their financial statements, their actions of lowering LLPs would be more cautious.

Table 14 The impacts of macroprudential regulation and credit contraction

	Dependent variable: Loan loss provisions / assets (*LLP*)			
	(1)	(2)	(3)	(4)
MPS	-0.0025**	-0.0037***	-0.0062***	-0.0060***
	(0.0010)	(0.0009)	(0.0015)	(0.0010)
MPP	-0.0001*			
	(0.0000)			
*MPS*MPP*	0.0007***			
	(0.0002)			
RQ		-0.0012		
		(0.0013)		
*MPS*RQ*		0.0307*		
		(0.0169)		
Creditgrowth_DC			-0.0005***	
			(0.0001)	
MPS ×Creditgrowth_DC			0.0044**	
			(0.0021)	
CreditGDP_DC				-0.0004***
				(0.0001)
*MPS*CreditGDP_DC*				0.0044***
				(0.0013)
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes

Bank FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Observations	795	879	879	879
Adjusted R^2	0.86	0.87	0.87	0.87

Notes: (1) This table presents estimation results for the moderating effect of macroprudential regulation and credit contraction on the MPS-LLP nexus, using fixed-effects estimation with robust standard errors clustered at bank level. (2) Dependent variable *LLP*: total loan loss provisions scaled by bank's total assets. Independent variables: *MPS*: monetary policy shock; *Creditgrowth_DC*: dummy variable equal to 1 if the current credit growth is lower than its trend value; *CreditGDP_DC*: dummy variable equal to 1 if the current credit-to-GDP ratio is lower than its trend value; *MPP*: the macroprudential policy index constructed by IMF; *RQ*: the regulation quality index constructed by World Bank; *MPS*Creditgrowth_DC*: the interaction between *MPS* and *Creditgrowth_DC*; *MPS*CreditGDP_DC*:: the interaction between *MPS* and *CreditGDP_DC*; *MPS*MPP*: the interaction between *MPS* and *MPP*; *MPS*RQ*: the interaction between *MPS* and *RQ*. Bank controls include *Size, EBTP, NPL, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

6.3 Banks' adjustments to LLPs and the conduct of monetary policy

Monetary policy aims to stabilize inflation and promote economic growth by influencing banks' ability to attract deposits and extend loans, thereby altering the money supply in circulation. Consequently, it is crucial to examine whether banks' behavior of manipulating reported earnings through adjustments to LLPs in response to MPS shocks, as demonstrated in our earlier results, affects the transmission of monetary policy.

To investigate this, we regress MPS on bank deposits (measured by the logarithm of total deposits) and loans (measured by the logarithm of total loans) to assess how monetary policy shocks impact banks' capacity to attract deposits and extend loans in our sample. As shown in Columns 1 and 3 of Table 15, the regression coefficient of MPS on bank loans is significantly negative, whereas the coefficient for bank deposits is not statistically significant. These results suggest that while tighter monetary policy significantly reduces bank loans in subsequent periods, its effect on deposits appears negligible.

Furthermore, we create a dummy variable, EM, to indicate whether a bank's adjustment in LLPs aligns with the direction of monetary policy. Specifically, EM equals 1 if a bank reduces its LLPs under an unexpected tightening of monetary policy or increases its LLPs under an unexpected loosening of monetary policy, indicating a higher likelihood of earnings manipulation; otherwise, EM equals 0. We include EM in the regression model and interact it with MPS. The regression models are then specified as follows:

$$\begin{aligned} \ln Loans_{i,t} &= \beta_0 + \beta_1 \ln Loans_{i,t-1} + \beta_2 MPS_{t-1} \times EM_{i,t-1} + \beta_3 MPS_{t-1} + \beta_4 EM_{i,t-1} \\ &\quad + \Upsilon Bankcontrols_{i,t-1} + \Phi Macrocontrols_{t-1} + \mu_1 Timetrend_{t-1} + \upsilon_i + \varepsilon_{i,t} \end{aligned} \tag{2}$$

$$\begin{aligned} \ln Deposits_{i,t} &= \beta_0 + \beta_1 \ln Deposits_{i,t-1} + \beta_2 MPS_{t-1} \times EM_{i,t-1} + \beta_3 MPS_{t-1} + \beta_4 EM_{i,t-1} \\ &\quad + \Upsilon Bankcontrols_{i,t-1} + \Phi Macrocontrols_{t-1} + \mu_1 Timetrend_{t-1} + \upsilon_i + \varepsilon_{i,t} \end{aligned} \tag{3}$$

This approach allows us to examine the influence of banks' earnings manipulation on the transmission of monetary policy through the banking sector. Specifically, by analyzing the interaction between EM and MPS, we assess whether banks' adjustments to reported earnings in response to monetary policy shocks enhance or hinder the intended effects of monetary policy on bank lending and deposit-taking activities. This analysis provides valuable insights into the complex relationship between regulatory policies, bank behavior, and the broader economic impacts of monetary policy decisions.

The results in Table 15 and Figure 2 show that when banks are more likely to manipulate LLPs (i.e., EM = 1), an unexpected tightening of monetary policy leads to a significantly larger increase in bank deposits. This aligns with the economic intuition that depositors prioritize bank stability more than borrowers do. In response to a contractionary monetary policy shock, banks engaging in earnings manipulation send more positive signals to depositors, encouraging them to increase their deposits.

On the lending side, the interaction term between EM and MPS has a positive coefficient, suggesting that banks' earnings manipulation may mitigate the negative impact of tight monetary policy on lending. However, the coefficient of this interaction term is not statistically significant. We hypothesize that this could be due to the simultaneous reduction in loan demand caused by tight monetary policy. Nevertheless, the positive coefficient underscores a potential issue: when faced with contractionary monetary policy, banks may engage in earnings manipulation to sustain their lending capacity, even though the decline in loan demand limits the effectiveness of this strategy.

In conclusion, on the deposit side, banks that engage in earnings manipulation attract significantly more deposits under tight monetary policy. On the lending side, banks may use earnings manipulation to sustain their lending capacity in the face of tight monetary policy. Taken together, these findings suggest that banks' earnings manipulation could lead to an increase in deposits and, consequently, the money supply under tight monetary policy. Since the objective of tight monetary policy is to reduce the money supply, our results indicate that banks' manipulation of LLPs may weaken the effectiveness of monetary policy.

As discussed in Section 3.3, a significant portion of M2 growth fluctuations arises from policymakers' systematic reactions to economic conditions (Chen et al., 2018). Consequently, using actual M2 growth as a measure of monetary policy introduces endogeneity problems. First, when examining how banks adjust their strategies to monetary policy shocks, the challenge lies in the fact that banks can anticipate policy changes based on macroeconomic signals and recalibrate their operations beforehand, making it difficult to isolate reactions driven purely by unexpected shocks. Second, households and firms also adjust their deposit and lending behaviors in anticipation of policy changes, further complicating the identification of policy transmission effects. Additionally, banks' strategic adjustments to anticipated monetary policy changes may influence households' and firms' financial decisions even before the policy is formally announced, adding another layer of complexity to identifying how banks' strategic responses to monetary policy shocks affect policy transmission.

By contrast, MPS captures the exogenous component of monetary policy and reflects unexpected policy changes (Lu et al., 2023). Using MPS helps mitigate these endogeneity concerns, enabling a more precise examination of banks' responses to monetary policy shocks and their role in policy transmission.

Table 15 The influence of banks' adjustments to LLPs on bank lending and deposits

	(1)	(2)	(3)	(4)
	lnDeposits	lnDeposits	lnLoans	lnLoans

L.MPS	-0.0082	-0.3643***	-0.1164**	-0.2462
	(0.0563)	(0.1152)	(0.0567)	(0.1691)
L.EM ×L.MPS		0.6602***		0.2421
		(0.2130)		(0.2538)
L.lnDeposits	0.6888	0.1414		
	(0.5586)	(0.5340)		
L.lnLoans			-0.0025	0.0642
			(0.3842)	(0.3605)
Lagged bank controls	Yes	Yes	Yes	Yes
Lagged macro controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Hansen test P value	0.1293	0.2488	0.1313	0.1001
AR(1) P value	0.0001	0.0001	0.0000	0.0000
AR(2) P value	0.2695	0.9531	0.5371	0.6261
Observations	786	786	786	786

Notes: (1) This table shows how banks' adjustments to LLPs in response to MPS influence banks' ability to attract deposits and extend loans. We use fixed-effects model with robust standard errors clustered at bank level, estimated with the two-step system GMM approach. (2) Dependent variables: *lnDeposits*: the logarithm of total deposits; *lnLoans*: the logarithm of total loans. Independent variables: *MPS*: monetary policy shock; *EM*: a dummy variable indicating whether a bank's Loan Loss Provision (LLP) adjustment direction aligns with the monetary policy direction in the current period. EM equals 1 if banks lower LLPs under unexpected tight monetary policy or raise LLPs under unexpected loose monetary policy, suggesting a higher probability of earnings manipulation; otherwise, it equals 0. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. All variables are lagged by one period. (3) Coefficients on controls are omitted for brevity. (4) The estimation period is 2008–2022. (5) *, ** and *** represent significance at 10%, 5% and 1%, respectively.

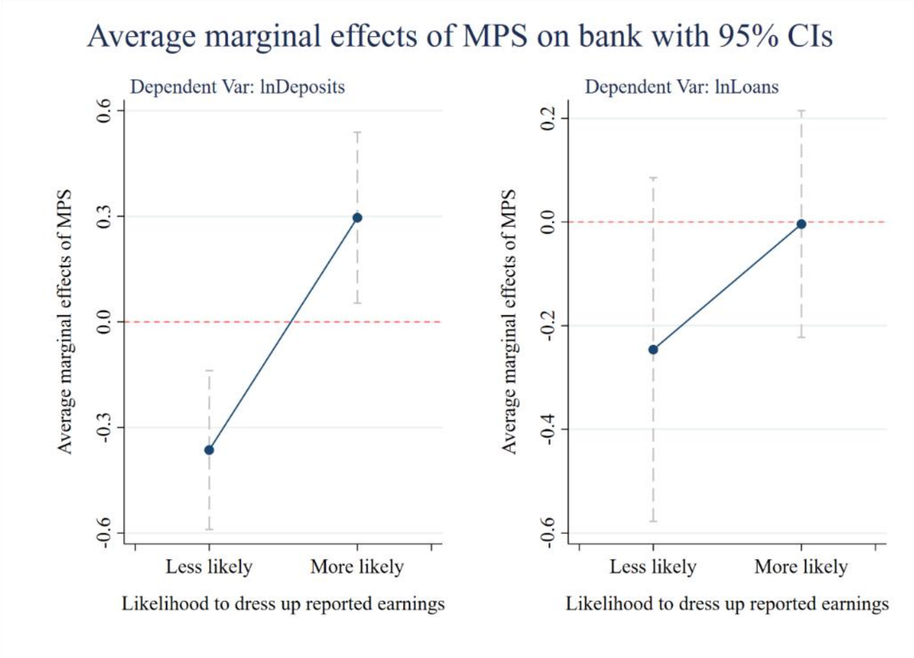

Fig.2 The influence of banks' adjustments to LLPs on bank lending and deposits

Notes: (1) This figure shows how banks' adjustments to LLPs in response to MPS influence banks' ability to attract deposits and extend loans. It illustrates the marginal effects of monetary policy on bank deposits (left panel) and loans (right panel) under different LLP adjustment scenarios. (2) Banks are considered "more likely" to dress up reported earnings when they either decrease LLPs during contractionary MPS, or increase LLPs during expansionary MPS. (3) Blue dots represent the marginal effect coefficients of monetary policy on deposits (left panel) and loans (right panel). Gray dashed lines indicate the 95% confidence intervals.

7. Conclusions and policy implications

In this paper, we examine whether and how monetary policy shock (MPS) affects banks' loan loss provisioning behavior. Using panel data of 88 Chinese banks over the period of 2008–2022, we find robust evidence that an increase in MPS leads to a decline in bank loan loss provisions (LLPs), which supports the hypothesis that banks are inclined to conceal risk by managing LLPs to increase their reported earnings under the adverse effects of monetary policy tightening. After addressing potential endogeneity issues and performing robustness checks in various ways, this conclusion remains valid.

Concerning the mechanism underpinning the inverse relationship between MPS and LLPs, our findings show that an increase in MPS precipitates a downturn in banks' loan performance and earnings. Moreover, banks characterized by higher levels of risk or poorer risk resilience exhibit a more pronounced reduction in LLPs in response to MPS. Further analysis reveals that, stricter macroprudential supervision and higher regulatory quality would urge banks to maintain higher levels of LLPs. In addition, during periods of credit contraction, banks are less inclined to diminish LLPs to shore up future earnings because reducing LLPs in such periods is more risky for banks to maintain anti-risk ability and satisfy regulatory requirements.

These findings should be of interest to regulators and policymakers. First, it is imperative for regulatory authorities to set up sound institutional frameworks governing the discretionary behavior of banks in managing LLPs. Specifically, they can supervise the formulation of expected loan loss models within the banking industry and refine the rules and standards for loan loss provisioning based on these models. Second, given the pivotal intermediary role that banks play in transmitting monetary policy effects to individuals in society, the accuracy of signals conveyed through bank LLPs is very important. Noises and inaccuracies in these signals pose a threat to the precision and efficacy of monetary policy transmission. Therefore, a careful and informed regulatory approach is vital to ensure the reliability of information conveyed by banks' loan loss provisioning behavior.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Data availability

Data will be made available on request.

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Appendix

Table 1 The impacts of MPR and RFOR on NPLTL and lnNPL

	(1)	(2)	(3)	(4)
	NPLTL	NPLTL	lnNPL	lnNPL
L.MPR	0.0000	0.0000	0.0002	0.0001
	(0.0000)	(0.0000)	(0.0001)	(0.0003)
L.RFOR	-0.0000	0.0000	-0.0002	0.0002
	(0.0000)	(0.0000)	(0.0002)	(0.0002)
L.MPS		0.0028		0.2462
		(0.0087)		(0.3531)
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
Observations	879	879	879	879
Adjusted R^2	0.42	0.44	0.95	0.96

Notes: (1) This table presents estimation results for regressions of NPLTL and lnNPL on MPR and RFOR, using fixed-effects estimation with robust standard errors clustered at bank level. (2) Dependent variables: *lnNPL*: the natural logarithm of non-performing loans; *NPLTL*: the ratio of the non-performing loans to total loans. Independent variables: *MPR*: the release time of the People's Bank of China's China Monetary Policy Report of the previous year; *RFOR*: the release time of the People's Bank of China's Regional Financial Operation Report of the previous year; *MPS*: monetary policy shock. Bank controls include *Size, EBTP, NPLgrowth, Loangrowth, CAR, LTA*. Macro controls include *GDPgrowth, CPI*, *RECI* and *GovExp*. Bank fixed effect and time trend are controlled in all regressions. (3) Coefficients on controls are omitted for brevity. (4) Robust standard errors, clustered at the bank level, are reported in parentheses. (5) The estimation period is 2008–2022. (6) *, ** and *** represent significance at 10%, 5% and 1%, respectively.