The Effects of Macro-prudential Policies on Bank Efficiency and Profitability: Evidence from the Micro-data of Chinese Banks

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Abstract

While the role of macroprudential policies in maintaining financial stability has been extensively studied, research on their impact on bank performance remains limited. This paper investigates the effects of macroprudential policies on bank efficiency and profitability, utilizing quarterly data from 37 Chinese banks between 2015 and 2017. We construct an aggregate macroprudential index based on six policy instruments, encompassing broad-based tools, corporate sector tools, household sector tools, liquidity tools, and structural tools. By applying a dynamic panel system generalized method of moments (GMM) approach, we find that tightened macroprudential policies significantly enhance bank efficiency while simultaneously reducing profitability. Conversely, loosened policies yield opposite effects. The findings remain robust across various measures of efficiency and profitability.

Keywords: *macro-prudential policy, bank efficiency, bank profitability, system GMM*

JEL Classification: *E44; F41; F42.*

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1 Introduction

The recent financial crisis exposed the systemic risks within the global financial system, sparking widespread discussions about the importance and necessity of macroprudential policies for maintaining financial stability. In response, the Chinese government also implemented various macroprudential tools during and after the crisis to safeguard its financial system.

While existing literature largely focuses on the effectiveness of macroprudential policies in managing bank credit and mitigating risks, there has been limited attention to their impact on bank efficiency and profitability—especially in the context of China. This paper aims to fill that gap in the research.

As a counter-cyclical policy tool, macroprudential policies regulate the financial system by adjusting the supply of bank credit in line with economic cycles. This means tightening credit during boom periods and loosening it when economic conditions worsen. These policies can influence bank efficiency and profitability in two key ways.

On one hand, tightening macroprudential policies during a credit boom restricts bank lending, which may negatively impact profitability by limiting growth opportunities during favorable times. On the other hand, tighter policies reduce banks' risk-taking during these periods, potentially improving efficiency through lower exposure to risk. As a result, a trade-off may exist between bank efficiency and profitability.

We employ the dynamic Generalized Method of Moments (GMM) panel methodology to estimate the impact of macroprudential policies on bank efficiency and profitability, utilizing quarterly data from 37 listed Chinese banks during the 2015-2017 period. To achieve this, we construct a quarterly cumulative macroprudential index that reflects the overall extent of these policies, incorporating six key instruments, including the capital adequacy ratio, liquidity ratio, and leverage ratio.

The primary sources for our macroprudential data include policy documents issued by the People's Bank of China and the China Banking Regulatory Commission. Additionally, we supplement our database with information from the chapter on macroprudential management in the China Financial Stability Report and the section on Financial Dynamics Supervision in the Financial Supervision Study report.

Our findings indicate that during periods of credit expansion, implementing tightening macro-

prudential policies effectively enhances bank efficiency, although it simultaneously reduces profitability, aligning with our expectations. Tight macroprudential measures restrict banks' high-risk activities, thereby lowering their risk exposure and improving overall efficiency. However, these low-risk practices typically yield lower returns, leading to a decline in earnings as high-risk investments decrease. Consequently, bank profitability diminishes due to the lower earnings associated with less risky business activities, while loose macroprudential policies yield the opposite effects. Notably, the impact of tight macroprudential policies on bank performance is more pronounced than that of loose policies.

We also conduct a series of robustness tests using different indicators for bank performance and macroprudential policies, and we find consistent results across these variations.

This paper relates to two strands of literature on macroprudential policies and banks. The first strand investigates the effects of macroprudential policies on regulating the procyclicality of credit growth, represented by studies such as (Richter, Schularick, & Shim, 2019), Bitar, Pukthuanthong, and Walker (2018), Zhang and Zoli (2016), Olszak, Roszkowska, and Kowalska (2016), and Bouwman (2013). For instance, Moreno (2011) finds that the reserve requirement ratio is more effective than the loan-to-value (LTV) ratio in curbing credit growth. Additionally, Jiménez, Ongena, Peydró, and Saurina (2013) shows that banks with higher capital provisions during economic upturns tend to experience lower credit growth.

The second strand explores the effects of macroprudential policies on bank risks. This literature demonstrates that tightening macroprudential policies can effectively curb credit growth (Akinci and Olmstead-Rumsey (2018)); Zhang and Zoli (2016); Olszak et al. (2016); Jiménez et al. (2013); Antipa, Mengus, and Mojon (2010)), and significantly reduce bank risk (Lacorte (2005); Altunbas, Binici, and Gambacorta (2018)).

While most studies focus on the effectiveness of macroprudential policies regarding banks' credit and risk, few examine their effects on bank efficiency and profitability. This paper addresses this gap by focusing specifically on China, an area that remains unexplored in the existing literature.

The rest of this paper is organized as follows: Section 2 presents the data, variable definitions and the construction of the macroprudential policy index for China. Section 3 present the empirical model, Section 4 discusses the empirical results, Section 5 provides robustness checks and Section 6 concludes the paper.

2 Data

In this section, we first construct a macroprudential policy index for China, covering the period from 2015 to 2017. Next, I introduce additional variables used in the paper and explain how the relevant index for the regression is constructed. Finally, I briefly discuss these variables.

Specifically, bank performance indicators and other control variables are primarily sourced from the Bankscope database, while China's macroprudential indicators are derived from policy documents issued by the China Banking Regulatory Commission. To enhance the clarity of the regression results, we perform several data transformations. For instance, we calculate the pre-tax profit divided by total assets to mitigate the impact of individual differences between banks. Furthermore, since the cost-to-income ratio is negatively correlated with bank efficiency, we treat this variable as its reciprocal to align the direction of all explanatory variables. Table 6 from Appendix A provides definitions and data sources for each variable used in the analysis.

2.1 China's macroprudential policy index

To build a database of China's macroprudential measures, we collected relevant data from various sources. The primary source for our macroprudential data is policy documents issued by the People's Bank of China and the China Banking Regulatory Commission. Additionally, we supplemented our database with information from the chapter on macroprudential management in the China Financial Stability Report and the chapter on Financial Dynamics Supervision from the Financial Supervision Research report.[1]

According to the 80th Annual Report of the Bank for International Settlements, "only tools that explicitly aim to maintain the stability of the overall financial system and have the most direct and reliable impact on financial stability should be considered as a macroprudential policy tool." Based on this criterion, we constructed the China Macroprudential Policy Database, as detailed in Table 6 from Appendix A.

Since these policies are challenging to quantify with specific values, this paper adopts the measurement approach from previous literature on macroprudential policies (E. Cerutti, Correa, Fiorentino, Segalla, and Esther (2015), M. E. M. Cerutti, Correa, Fiorentino, and Segalla (2016);

[1]The China Financial Stability Report is an annual statistical publication by the People's Bank of China, while the Financial Supervision Research is a monthly journal published by the China Banking Regulatory Commission.

Lim et al. (2011); Kuttner and Shim (2013)), using dummy variables. Positive and negative values indicate the direction of policy application (Akinci and Olmstead-Rumsey (2018); Altunbas et al. (2018)). Specifically, a tightening macroprudential policy is assigned a value of +1, while a loosening policy is assigned -1. If no action was taken in a given quarter, the variable is assigned a value of 0.

We count the macro-prudential policies using three indices. The first index is the country's overall accumulated macroprudential index in each quarter $\text{MPP}_{\text{separate}}$ as our variable. For example, in the first quarter of 2015, two tightening and one loose macro-prudential policies were implemented. A loose macro-prudential policy was implemented in that quarter, and the $\text{MPP}_{\text{separate}}$ variable was counted as +1 and -1 for the two quarters. The second index is the country's overall accumulated macroprudential policy index over the entire study period $\text{MPP}_{\text{aggregate}}$, because macroprudential measures can affect bank efficiency and profitability not just in the quarter of implementation but in subsequent quarters as well. The $\text{MPP}_{\text{separate}}$ indices are summed to indicate the cumulative effect of policy implementation. In this way, the $\text{MPP}_{\text{aggregate}}$ values for the first and second quarters of 2015 should be counted as +1 and 0, respectively. That is, the sum of the $\text{MPP}_{\text{separate}}$ index from the first quarter and the second quarter forms the $\text{MPP}_{\text{aggregate}}$ index for the second quarter. The first approach reflects immediate changes in macroprudential policy during each quarter, while the second approach emphasizes the cumulative effect of these policies. Additionally, to test the impact of policy implementation direction on bank performance, we divide the macro-prudential policy indicators into tight macro-prudential policy $\text{MPP}_{\text{tight}}$ and loose macro-prudential policy MPP_{ease}. For example, in the first quarter of 2015, two tightening and one loose macro-prudential policies were implemented. A loose macro-prudential policy was also implemented in the second quarter. The $\text{MPP}_{\text{tight}}$ variable and the MPP_{ease} variable were counted as 2 and 1, respectively, in the first quarter, and as 0 and 1, respectively, in the second quarter.

To illustrate the use of macroprudential policies in China, Figure 1 shows the evolution of China's macroprudential measures introduced in each quarter of our sample from 2015Q1 to 2017Q4. The bar chart depicts the implementation of the quarterly indicator $\text{MPP}_{\text{separate}}$, while the line chart illustrates the trend of the quarterly cumulative indicator $\text{MPP}_{\text{aggregate}}$. We found that China's macroprudential policy was continuously loose before the 4th quarter of 2015, and it showed a continuous tightening trend after 2015.

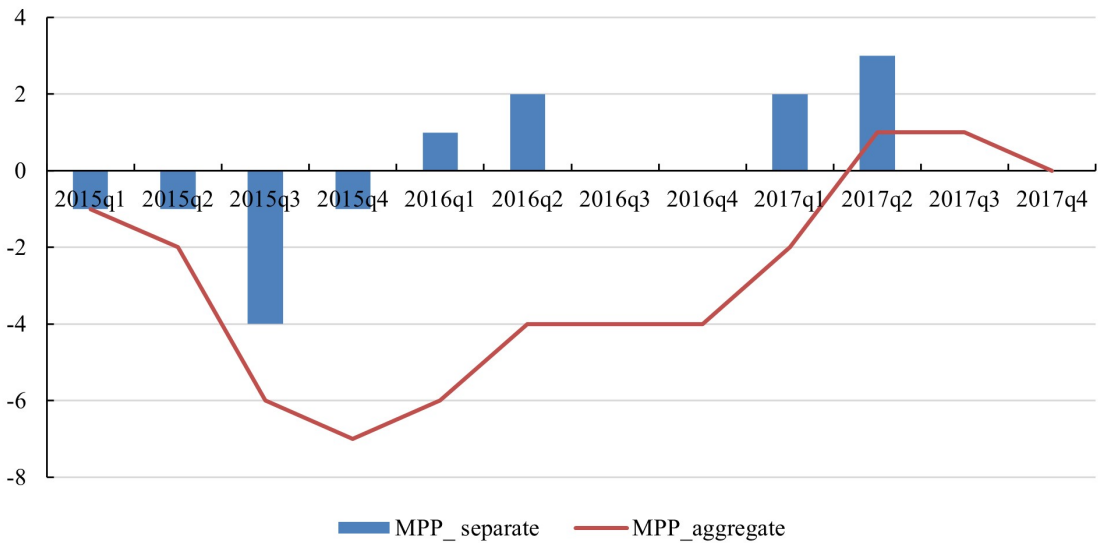

Figure 1: Usage of MPP Use, 2015:Q1–2017:Q4

Figure 2 shows the implementation of tight and loose macroprudential policies in China. Before 2015, China primarily enacted loose macroprudential policies, which gradually decreased in subsequent years. In contrast, the adoption of tightening macroprudential policies began to rise after 2015. During that year, amid insufficient global economic recovery and China's transition to a new normal state, the downward pressure on the macroeconomy remained significant. To invigorate the financial market, more loose macroprudential policies were introduced. In the following two years, as the economy steadily grew, China's macro-control policies shifted focus towards enhancing financial supervision and mitigating systemic risks. Additionally, with the ongoing improvement of China's macroprudential regulatory framework, a greater number of tightening macroprudential policies were implemented.

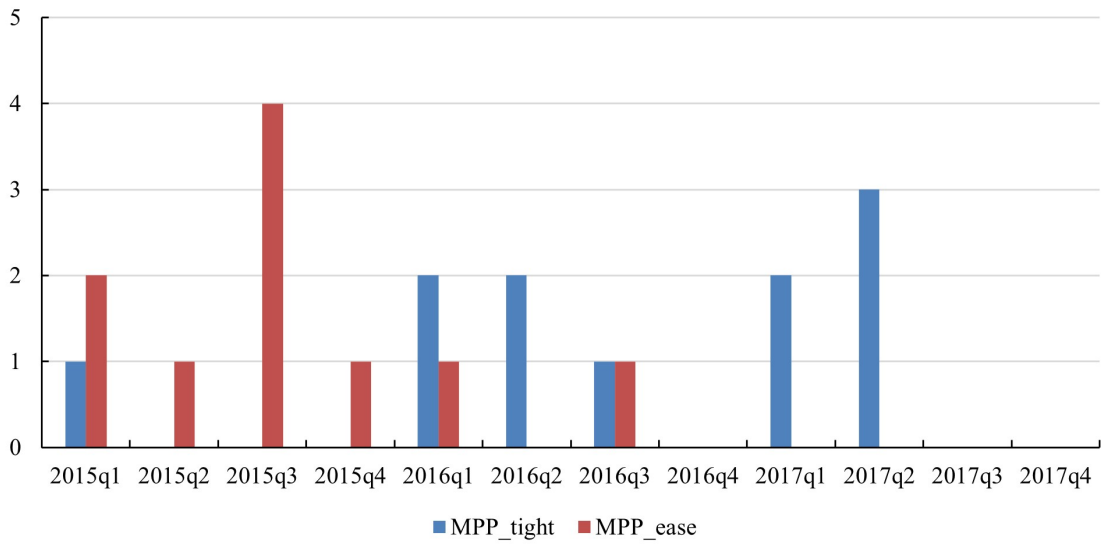

Figure 2: Usage of tight and loosen of macro-prudential policies, 2015:Q1–2017:Q4

2.2 Other variables

2.2.1 Bank Efficiency

Bank performance can be measured in terms of both efficiency and profitability. This paper employs the bank cost-to-income ratio (CIR) as a measure of bank efficiency. The CIR is calculated as the ratio of operating expenses to operating income, reflecting the cost associated with each unit of income earned by the bank. A lower CIR indicates higher bank efficiency. This indicator has been utilized in various studies to assess bank efficiency (Bitar et al., 2018; Chortareas, Girardone, & Ventouri, 2012).

For robustness checks, we also consider the ratio of non-operating items to average assets (NITAA) to measure bank efficiency, where higher values signify greater operating costs and lower efficiency (Bitar, Hassan, & Walker, 2017). Non-operating items are computed as follows:

$$\text{Non-operating items} = \text{Net non-operating income} + \text{Profit or loss from acquisition or disposal of subsidiaries} - \text{Impairment of other assets} - \text{Taxes}.$$

2.2.2 Bank Profitability

To capture bank profitability, we use the net interest margin (NIMP). This ratio is calculated as:

$$\text{NIMP} = \frac{\text{Interest income} - \text{Interest expenses}}{\text{Total earning assets}}.$$

The NIMP reflects the bank's fundamental operating characteristics, serving as a credit intermediary to absorb deposits and issue loans. A higher NIMP indicates a stronger ability for banks to profit from their core liabilities and asset operations (**??**).

For robustness checks, we also utilize the return on average assets (RoAA), profit before tax (PbT), and the ratio of other operating income to average assets (OOIAA) as additional measures of bank profitability. RoAA is defined as:

$$\text{RoAA} = \frac{\text{Net income}}{\text{Total assets}},$$

reflecting the ability of bank assets to generate profits. PbT is calculated as:

$$\text{PbT} = \frac{\text{Profit before tax}}{\text{Total assets}},$$

indicating net profit before the bank pays income tax. OOIAA measures the proportion of fees and other operating income relative to a bank's average assets. A higher value in these indicators suggests a stronger capacity for banks to generate profits.

2.2.3 Bank-Level Control Variables

Several bank-level control variables are included in the analysis:

Bank Size (SIZE): Represented by the logarithm of the bank's total assets, this variable controls for differences in operational performance between large and small banks, attributable to economies of scale and portfolio diversification. Larger banks typically exhibit enhanced efficiency and reduced risk exposure Athanasoglou, Brissimis, and Delis (2008); Danisewicz, Reinhardt, and Sowerbutts (2015).

Net Loan to Total Assets Ratio (NLTA): This ratio measures bank liquidity. Literature suggests that banks with substantial loan portfolios engage in less risk-taking compared to those focusing on

financial derivatives and non-traditional activities. Additionally, the supervisory costs of traditional loan activities are lower than those for non-traditional activities, leading to reduced operating costs and increased profitability for banks Bitar et al. (2018).

Total Assets Growth Rate (GRTA): This variable represents the bank's development strategy and controls for the impact of balance sheet expansion. During their development, banks may attract more skilled employees and mitigate information asymmetry, which improves credit risk management capacity and enhances business performance Abedifar, Molyneux, and Tarazi (2013).

Income Diversification Degree (INCODI): This variable indicates the extent to which banks diversify between lending and non-lending activities. Some studies have shown that non-interest income is linked to more volatile returns Bitar et al. (2018), while Abedifar et al. (2013) found a negative relationship between non-interest income and bank interest margins. Income diversity is calculated using the method outlined by Laeven and Levine (2007).

To account for potential time effects due to omitted variables, this paper includes quarterly dummy variables (Q1, Q2, Q3) to control for fixed time effects. Variable definitions and data sources are provided in Table 1.

2.3 Descriptive statistics

Table 1: Summary statistics

Variables	N	Mean	Std. Dev.	Minimum	5th Pctl.	Median	75th Pctl.	Maximum
CIR	200	3.14	0.83	1.34	2.62	3.03	3.61	9.47
NITAA	287	-0.33	0.18	-1.20	-0.39	-0.32	-0.23	0.07
NIM	280	2.52	0.56	1.16	2.15	2.48	2.85	4.17
RoAA	287	1.01	0.22	0.51	0.86	1.00	1.14	1.82
PbT	200	0.00	0.00	0.00	0.00	0.00	0.00	0.01
SIZE	280	14.36	1.70	11.18	13.20	14.40	15.62	17.08
NLTA	280	43.08	8.70	22.62	35.62	45.39	49.99	56.84
INCODI	200	0.85	0.25	0.13	0.70	0.92	1.04	1.40
GRTA	194	0.03	0.03	-0.09	0.01	0.03	0.04	0.18

Table 1 presents the summary statistics of the explanatory variables and bank-level control variables. The sample includes 444 observations from 37 banks across 12 quarters; however, some missing values are evident. This can be attributed to certain banks beginning to disclose financial information only after 2015, while others publish only semi-annual or annual financial reports. Nevertheless, the

number of available observations is still adequate to ensure the accuracy of our tests.

Comparing the mean and standard deviation of each variable, we observe that, except for the standard deviation of the growth rate of total assets—which is slightly higher than the mean—the standard deviations of the other variables are lower than their respective means. This suggests that the data does not exhibit significant fluctuations and lacks extreme values.

3 Empirical model

In this section, I introduce the empirical model used to estimate the impact of macroprudential policies on bank performance.

One potential concern with the identification is that the condition of the banking sector can also influence macroprudential policy decisions. To address potential endogeneity issues, we employ the dynamic Generalized Method of Moments (GMM) panel methodology to obtain consistent estimates of the impact of macroprudential policies on bank efficiency and profitability, utilizing quarterly data from 37 listed banks in China from 2015 to 2017. This methodology, initially proposed by (Holtz-Eakin, Newey, & Rosen, 1988) and (Arellano & Bond, 1991), and further developed by (Blundell & Bond, 1998), reduces any endogeneity bias that may affect the estimation coefficients in the regression model. It also mitigates endogeneity concerns arising from omitted variables that influence banks.

The empirical regression model is specified as follows:

$$Y_{it} = \beta_0 Y_{it-1} + \beta_1 MPP_t + \beta_2 BankControl_{it} + TimeDummy_i + \mu_i + \varepsilon_{it} \quad (1)$$

where i denotes the individual banks, t indicates the time period, μ_i represents the bank-specific fixed effects, and $TimeDummy_i$ controls for quarterly fixed effects. The dependent variable Y_{it} represents bank efficiency indicators (CIR, NITAA) and bank profitability indicators (NIM, RoAA, PbT, OOIAA) for bank i at time t. We include one lag of the dependent variable to address potential serial correlation in the error terms.

The variable MPP_t is the macroprudential policy index, which includes four dimensions: $MPP_{separate}$, $MPP_{aggregate}$, MPP_{tight}, and MPP_{ease}. As previously discussed, we assess the country's overall macroprudential policies in three ways:

Cumulative Macroprudential Policy Index (MPP_separate): This index reflects the overall accumulated macroprudential measures implemented in each quarter.

Overall Accumulated Macroprudential Policy Index (MPP_aggregate): This index considers the cumulative effect of macroprudential policies over the entire study period, acknowledging that these measures can affect bank efficiency and profitability not only in the quarter of implementation but also in subsequent quarters.

Tight and Loose Macroprudential Policy Indicators: These are defined as MPP_{tight} and MPP_{ease} respectively, distinguishing between restrictive and accommodative policies.

Additionally, we include a vector of bank control variables, $BankControl_{it}$, which encompasses the following indicators: Bank Size (SIZE): This indicator controls for differences in operating performance between large and small banks, influenced by economies of scale and portfolio diversification. Net Loan to Total Assets Ratio (NLTA): This ratio measures bank liquidity. Total Assets Growth Rate (GRTA): This variable represents the bank's development strategy, controlling for the impact of balance sheet expansion. Income Diversification Degree (INCODI): This indicator assesses the extent to which banks diversify between lending and non-lending activities.

4 Empirical results

In this section, using quarterly data from 37 listed Chinese banks from 2015 to 2017, we employ the dynamic Generalized Method of Moments (GMM) panel methodology to estimate the impact of macroprudential policies on bank efficiency and bank profitability.

Table 2: Panel estimation results: MPP_aggregate , 2015:Q1-2017:Q4.

Explained variable	Bank Efficiency		Bank Profitability			
	(1)	(2)	(3)	(4)	(5)	(6)
	CIR	NITAA	NIM	RoAA	PbT	OOIAA
Explained variable, L1	-0.0222	-0.128	0.466***	0.641***	0.215**	0.254***
	(-0.34)	(-1.60)	(3.46)	(6.88)	(2.60)	(8.57)
MPP_aggregate	0.0534**	0.0236***	-0.0293**	-0.00932**	-0.0000647***	-0.0133***
	(2.92)	(3.70)	(-2.76)	(-2.98)	(-3.78)	(-6.85)
SIZE	0.384*	-0.0490*	0.0758	-0.0205	-0.000102	-0.0308*
	(2.06)	(-1.99)	(1.24)	(-1.54)	(-1.08)	(-2.09)
NLTA	-0.0568	0.0104*	-0.00314	0.00495*	0.0000284	0.00545*
	(-1.95)	(2.49)	(-0.28)	(2.11)	(1.66)	(2.08)
INCODI	-1.020	0.0729	-1.771***	0.319***	0.00163***	1.652***
	(-0.83)	(0.40)	(-5.75)	(5.82)	(3.52)	(28.51)
GRTA	-1.767	0.701	-0.164	-0.138	0.00233	0.780**
	(-0.59)	(1.70)	(-0.31)	(-0.39)	(1.39)	(3.17)
Q1 dummy	0.0570	0.0482	-1.105***	0.252***	0.00195***	0.965***
	(0.08)	(0.75)	(-5.91)	(7.44)	(9.07)	(25.69)
Q2 dummy	0.301	-0.0245	-0.379***	0.0845***	0.00119***	0.319***
	(0.88)	(-0.85)	(-5.36)	(3.96)	(9.39)	(18.07)
Q3 dummy	0.146	-0.0184	-0.206***	0.0331**	0.000849***	0.121***
	(0.54)	(-0.69)	(-4.74)	(2.60)	(7.87)	(9.40)
Intercept	1.034	-0.138	2.179**	0.0522	-0.000118	-1.091***
	(0.74)	(-0.46)	(2.77)	(0.30)	(-0.10)	(-7.36)
Observations	171	190	194	190	171	190
AR(2) test-value	0.276	0.398	0.050	0.954	0.919	0.454
Hansen test-p value	1.000	1.000	1.000	1.000	1.000	1.000

Notes: MPP_aggregate is the cumulative macroprudential policy index. The estimates are obtained using Arellano–Bond (AB) GMM method. The Hansen tests of exogeneity of instrument subsets are not rejected. Test for null hypothesis of no first order autocorrelation in levels (AR(2)) is not rejected. Robust standard errors are in parentheses.*p<0.1, **p<0.05, ***p<0.01. L1 represent a firs order lag.

We estimate the empirical model by pooling quarterly data from 37 listed banks in China for the period from 2015:Q1 to 2017:Q4. The regression results for the cumulative macroprudential policy indicators ($MPP_{aggregate}$) are presented in Table 2. Columns (1)-(6) correspond to various

dependent variables representing different aspects of bank performance.

The regression results indicate that during the period of credit expansion, the implementation of tightening macroprudential policies has improved bank efficiency while simultaneously reducing bank profitability, aligning with our expectations. This suggests that macroprudential policies significantly influence bank performance, albeit with opposing effects on efficiency and profitability. Specifically, tight macroprudential policies enhance bank efficiency but detract from profitability.

The divergence in these effects can be attributed to the way we measure bank efficiency—focusing on operating costs. Tightening macroprudential policies limits banks' high-risk business practices, which in turn reduces the costs associated with risk management. While this leads to increased efficiency, it also results in lower returns since low-risk business practices tend to yield relatively modest profits. Consequently, a reduction in high-risk investment behaviors inevitably leads to diminished earnings, thus explaining the observed decline in bank profitability. Conversely, loose macroprudential policies tend to produce the opposite effects.

Table 3: Panel estimation results: MPP_tight , 2015:Q1-2017:Q4

Explained variable	Bank Efficiency		Bank Profitability			
	(1)	(2)	(3)	(4)	(5)	(6)
	CIR	NITAA	NIM	RoAA	PbT	OOIAA
Explained Variable, L1	0.0199	-0.0460	0.565***	0.693***	0.235*	0.292***
	(0.20)	(-0.61)	(5.17)	(8.27)	(2.32)	(10.52)
MPP_tight	0.104	0.0276	-0.0522**	-0.0299***	-0.000167***	-0.0209***
	(1.54)	(1.37)	(-3.11)	(-4.39)	(-4.01)	(-3.95)
SIZE	0.273	0.0180	0.0478	-0.0144	-0.000193	-0.0350**
	(1.52)	(0.66)	(1.04)	(-1.48)	(-1.65)	(-2.73)
NLTA	-0.0493*	-0.00562	-0.000571	0.00302	0.0000258	0.00632**
	(-2.21)	(-1.28)	(-0.07)	(1.65)	(1.45)	(2.69)
INCODI	-0.883	-0.0740	-1.805***	0.312***	0.00162**	1.649***
	(-0.79)	(-0.50)	(-5.12)	(5.44)	(2.79)	(26.32)
GRTA	-2.927	-0.195	-0.173	-0.176	0.00161	1.037***
	(-0.95)	(-0.49)	(-0.37)	(-0.45)	(0.68)	(4.28)
Q1 dummy	-0.0683	-0.0886	-1.027***	0.312***	0.00230***	1.013***
	(-0.09)	(-1.27)	(-5.64)	(8.29)	(7.21)	(25.18)
Q2 dummy	0.167	-0.0811	-0.323***	0.129***	0.00146***	0.337***
	(0.42)	(-1.42)	(-5.81)	(7.30)	(10.25)	(20.42)
Q3 dummy	0.164	-0.00292	-0.220***	0.0267*	0.000818***	0.110***
	(0.60)	(-0.12)	(-5.12)	(2.37)	(7.23)	(8.88)
Intercept	1.951	0.395	2.349**	0.0331	0.00149	-1.060***
	(0.86)	(1.32)	(2.71)	(0.22)	(0.99)	(-6.72)
Observations	171	190	194	190	171	190
AR(2) test-value	0.220	0.418	0.044	0.897	0.982	0.866
Hansen test p-value	1.000	1.000	1.000	1.000	1.000	1.000

Notes: MPP_tight is the tight Macro-prudential policy accumulated in each quarter. The estimates are obtained using Arellano–Bond (AB) GMM method. The Hansen tests of exogeneity of instrument subsets are not rejected. Test for null hypothesis of no first order autocorrelation in levels (AR(2)) is not rejected. Robust standard errors are in parentheses.*p<0.1, **p<0.05, ***p<0.01. L1 represent a firs order lag.

Table 3 and Table 4 examine the impact of tight or loose macroprudential policies on bank performance. The regression results in Table 3 reveal that, in columns (1) and (2), although the indicators for tightening macroprudential policies are positive, their effect on bank efficiency

is not statistically significant. However, in the subsequent regressions presented in columns (3)-(6), the macroprudential policy indicators consistently show a significant negative impact on bank profitability at the 1

These findings indicate that while tightening macroprudential policies significantly reduce bank profitability, the improvement in operational efficiency is not pronounced. This may be attributed to the relatively short time period of the sample data from China, which primarily reflects the short-term effects of macroprudential policies. In the short term, tight macroprudential policies can restrict banks' loan supply and other risky business activities, leading to a decrease in revenue sources and, consequently, lower profits.

Table 4: Panel estimation results: MPP_ease , 2015:Q1-2017:Q4

Explained variable	Bank Efficiency		Bank Profitability			
	(1)	(2)	(3)	(4)	(5)	(6)
	CIR	NITAA	NIM	RoAA	PbT	OOIAA
Explained Variable, L1	-0.0257	-0.0846	0.575***	0.701***	0.184	0.289***
	(-0.37)	(-0.98)	(4.07)	(9.46)	(1.68)	(8.39)
MPP_ease	-0.195***	-0.0669***	0.0437	0.0164**	0.000170***	0.0391***
	(-3.64)	(-3.79)	(1.55)	(2.91)	(5.92)	(7.74)
SIZE	0.172	-0.0519*	0.138	-0.0170	-0.000251	-0.0205*
	(0.82)	(-2.02)	(1.76)	(-1.71)	(-1.72)	(-2.01)
NLTA	-0.0355	0.0125**	-0.0113	0.00382*	0.0000333	0.00364
	(-1.57)	(3.06)	(-0.84)	(2.04)	(1.67)	(1.89)
INCODI	-0.950	0.0157	-1.714***	0.325***	0.00180**	1.670***
	(-0.83)	(0.09)	(-4.62)	(6.50)	(2.98)	(26.02)
GRTA	-2.858	0.631	-0.204	-0.141	0.00193	0.882***
	(-0.92)	(1.72)	(-0.35)	(-0.35)	(0.81)	(3.72)
Q1 dummy	0.122	0.0297	-1.109***	0.255***	0.00200***	0.970***
	(0.18)	(0.46)	(-5.10)	(7.08)	(6.29)	(22.20)
Q2 dummy	0.399	0.0151	-0.438***	0.0616**	0.00112***	0.290***
	(1.20)	(0.47)	(-5.61)	(2.82)	(8.25)	(16.64)
Q3 dummy	0.331	0.0528*	-0.281***	0.00666	0.000661***	0.0742***
	(1.36)	(2.40)	(-4.06)	(0.55)	(6.11)	(5.56)
Intercept	3.058	-0.171	1.398	0.0104	0.00195	-1.171***
	(1.29)	(-0.54)	(1.62)	(0.08)	(1.02)	(-7.44)
Observations	171	190	194	190	171	190
AR(2) test-value	0.313	0.724	0.061	0.892	0.894	0.883
Hansen test-p value	1.000	1.000	1.000	1.000	1.000	1.000

Notes: MPP_ease is the loosen Macro-prudential policy accumulated in each quarter. The estimates are obtained using Arellano–Bond (AB) GMM method. The Hansen tests of exogeneity of instrument subsets are not rejected. Test for null hypothesis of no first order autocorrelation in levels (AR(2)) is not rejected. Robust standard errors are in parentheses.*p<0.1, **p<0.05, ***p<0.01. L1 represent a firs order lag.

In Table 4, the effects of loose macroprudential policies on bank efficiency and profitability are observed to be the opposite of those associated with tight policies. Specifically, loose macroprudential policies positively influence bank profitability while negatively impacting bank efficiency,

aligning with our expectations. The profit-seeking nature of commercial banks drives them to prioritize high-yield business activities. When loose macroprudential policies are implemented, banks' profit motives intensify, leading to increased risk in their operations and reduced control over operating costs, which significantly diminishes efficiency.

Conversely, while tightening macroprudential policies may lead banks to enhance their control over credit, the impact is not statistically significant, likely due to a lack of effective incentives. Nevertheless, the overall regression results presented in Tables 5 and 6 remain consistent with the prior findings.

5 Robustness checks

5.1 Robustness Checks

In this section, we assess the robustness of our results concerning different bank performance indicators and the macroprudential policy indicator.

5.1.1 Macroprudential Policy Indicator

We examine whether the effect of macroprudential policy remains significant when employing different macroprudential policy indices. Specifically, we use the country's overall accumulated macroprudential index for each quarter (denoted as MPP_separate) as our macroprudential policy indicator. For instance, in the first quarter of 2015, two tightening and one loosening macroprudential policies were implemented. The loose macroprudential policy was reflected in the MPP_separate variable as +1 for the quarter, while the tightening policies were represented as -1 in the subsequent two quarters.

This variable emphasizes short-term changes in macroprudential policy and can be employed to evaluate shifts in policy.

Table 5: Panel estimation results: MPP_separate , 2015:Q1-2017:Q4

Explained variable	Bank Efficiency		Bank Profitability			
	(1)	(2)	(3)	(4)	(5)	(6)
	CIR	NITAA	NIM	RoAA	PbT	OOIAA
Explained Variable, L1	-0.0208	-0.110	0.476***	0.644***	0.147	0.276***
	(-0.21)	(-1.17)	(3.42)	(9.28)	(1.52)	(10.21)
MPP_separate	0.162**	0.0279***	-0.0557*	-0.0228***	-0.000172***	-0.0304***
	(3.29)	(3.94)	(-2.45)	(-4.15)	(-6.71)	(-6.88)
SIZE	0.307	-0.0377	0.0870	-0.0125	-0.000200	-0.0282*
	(1.60)	(-1.37)	(1.31)	(-1.19)	(-1.64)	(-2.46)
NLTA	-0.0489*	0.0110*	-0.00827	0.00288	0.0000243	0.00416*
	(-2.10)	(2.52)	(-0.71)	(1.45)	(1.29)	(2.06)
INCODI	-1.075	0.0695	-1.757***	0.329***	0.00176**	1.660***
	(-0.89)	(0.40)	(-5.19)	(6.18)	(3.02)	(25.87)
GRTA	-2.107	0.584	-0.246	-0.180	0.00143	0.806**
	(-0.71)	(1.69)	(-0.45)	(-0.49)	(0.63)	(3.28)
Q1 dummy	-0.269	-0.00998	-0.997***	0.299***	0.00230***	1.028***
	(-0.35)	(-0.15)	(-5.22)	(7.72)	(7.64)	(24.17)
Q2 dummy	0.0183	-0.0425	-0.309***	0.119***	0.00152***	0.362***
	(0.05)	(-1.20)	(-4.36)	(5.31)	(11.03)	(20.57)
Q3 dummy	0.275	0.0148	-0.262***	0.0102	0.000712***	0.0897***
	(1.09)	(0.63)	(-5.19)	(0.88)	(6.39)	(7.06)
Intercept	1.739	-0.378	2.286*	0.0406	0.00177	-1.058***
	(0.74)	(-1.12)	(2.40)	(0.31)	(1.12)	(-6.72)
Observations	171	190	194	190	171	190
AR(2) test-value	0.256	0.500	0.050	0.884	0.820	0.992
Hansen test p-value	1.000	1.000	1.000	1.000	1.000	1.000

Notes: MPP_separate is the Macro-prudential policy accumulated in each quarter. The estimates are obtained using Arellano–Bond (AB) GMM method. The Hansen tests of exogeneity of instrument subsets are not rejected. Test for null hypothesis of no first order autocorrelation in levels (AR(2)) is not rejected. Robust standard errors are in parentheses.*p<0.1, **p<0.05, ***p<0.01. L1 represent a firs order lag.

Table 5 reports the regression results for the macroprudential policy indicators in each quarter

(MPP_separate). Columns (1)-(6) correspond to different explained variables representing bank performance. The macroprudential policy indicators (MPP_separate) were significant across all six regression groups, showing a positive correlation with bank efficiency and a negative correlation with bank profitability. This finding aligns with the regression results presented in Table 4, indicating relative stability in our test results. Notably, the absolute value of the coefficient for the MPP_separate index is larger than that of the MPP_aggregate index. This discrepancy suggests that MPP_separate places greater emphasis on short-term policy changes compared to the more moderate overall cumulative indicator (MPP_aggregate), which aligns with our expectations regarding the larger absolute value of the MPP_separate coefficient.

5.1.2 Bank Efficiency Indicators

For our main regression, we utilize the bank cost-to-income ratio (CIR) as a measure of bank efficiency. To further validate our findings, we also consider the ratio of non-operating items to average assets (NITAA) for robustness checks. Higher NITAA values indicate greater operating costs and lower efficiency (Bitar et al., 2018).

5.1.3 Bank Profitability Indicators

We employ the net interest margin (NIMP) to capture bank profitability in the main regression. For robustness checks, we also consider additional measures: return on average assets (RoAA), profit before tax (PbT), and the ratio of other operating income to average assets (OOIAA). Higher values across these indicators suggest a stronger capacity for banks to generate profits.

We estimate Model (1) using these indicators for robustness checks. The regression results are reported in columns (2) and (4)-(6) of Tables 4-7. The findings indicate that during periods of credit expansion, the implementation of tightening macroprudential policies has improved bank efficiency while simultaneously reducing bank profitability, consistent with prior results. Thus, while macroprudential policies significantly affect bank performance, their impacts on bank efficiency and profitability are inversely related: tightening policies enhance efficiency but diminish profitability.

6 Conclusions

The global financial crisis has heightened research interest in macroprudential policies. In response to the crisis, the Chinese government implemented various macroprudential tools aimed at maintaining financial stability. However, existing literature predominantly focuses on the role of macroprudential policies in regulating credit, often neglecting their impact on bank profitability and efficiency. This paper addresses this gap by utilizing the dynamic Generalized Method of Moments (GMM) panel methodology to estimate the effects of macroprudential policies on bank performance, based on quarterly data from 37 listed banks in China from 2015 to 2017.

To achieve this, we constructed a novel macroprudential policies index covering the period from 2015:Q1 to 2017:Q4. The primary sources for our macroprudential data include policy documents issued by the People's Bank of China and the China Banking Regulatory Commission. Additionally, we supplemented our database with chapters on macroprudential management from the China Financial Stability Report and on Financial Dynamics Supervision from the Financial Supervision Study report.

Our findings indicate that during periods of credit expansion, the implementation of tightening macroprudential policies effectively enhances bank efficiency while simultaneously reducing profitability, aligning with our expectations. Tight macroprudential measures restrict banks' engagement in high-risk business activities, thereby decreasing their risk exposure and improving efficiency. However, such low-risk practices yield relatively lower returns, resulting in diminished earnings for banks. Conversely, looser macroprudential policies have the opposite effect.

Further analysis reveals that the impact of tightening macroprudential policies on bank performance is more pronounced than that of loosening policies. We conducted a series of robustness tests with various bank performance indicators and macroprudential policy measures, confirming the consistency of our results.

The implications of our findings are significant for regulators and policymakers, particularly in China. While tightening macroprudential policies can effectively enhance bank efficiency, they also risk diminishing profitability. Therefore, regulators must carefully consider the potential adverse effects of these policies on the banking sector. It is crucial for policymakers to strike a balance between efficiency and profitability when formulating macroprudential regulations.

Future research on the impact of macroprudential policy on bank performance should broaden its scope to include banks in different countries and extend the time frame of analysis. This would allow for the differentiation between periods of financial crisis and normalcy, further enriching our understanding of how macroprudential policies influence bank performance.

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A Appendix: Data Processing

Table 6: Variable definitions and data sources

Type	Variable	Notation	Data Sources
Explained variable: bank efficiency	CIR	cost-to-income ratio	Bank scope Database
	NITAA	non-operating items to average assets	Bank scope Database
Explained variable: bank profitability	NIM	net interest margin	Bank scope Database
	RoAA	return of average assets	Bank scope Database
	PbT	profit before tax	Authors' calculations
	OOIAA	other operating income to average assets	based on Bank scope
Macro-prudential policy	MPP_separate	country's overall Macro-prudential policy index	Authors' calculations
	MPP_aggregate	country's overall Macro-prudential policy accumulate index	Authors' calculations
	MPP_tight	country's overall Tight Macro-prudential policy	Authors' calculations
	MPP_ease	country's overall Loosen Macro-prudential policy	Authors' calculations
Control Variable	SIZE	bank size	Authors' calculations
	GRTA	total assets growth rate	based on Bank scope
	INCODI	income diversity	based on Bank scope
	NLTA	the ratio of net loan to total assets	Bank scope Database
	Q_i	quarterly dummy	Authors' calculations

Specifically, the variables are defined as follows: CIR represents the cost-to-income ratio, calculated as the ratio of operating expenses to operating income. $NITAA$ is the net non-operating income to average assets, which is derived as (net non-operating income + profit or loss from acquisition or disposal of subsidiaries - impairment of other assets - taxes) / average assets . NIM stands for net interest margin, which is bank interest income minus bank interest expenses as a percentage of earning assets. $RoAA$ refers to the return on average assets, calculated as the ratio of net income to total assets. PbT is defined as (operating profit + share of equity accounted for joint ventures + non-operating income - non-operating expenses + profit or loss from acquisition and disposal of subsidiaries) / total assets . $OOIAA$ measures bank fees and other operating income as a percentage of average assets.

In terms of macroprudential policies, $MPP_{separate}$ is the country's overall macroprudential policy accumulated each quarter, while $MPP_{aggregate}$ is the sum of the macroprudential policy index over the entire study period. MPP_{tight} and MPP_{ease} represent accumulated tightening and loosening macroprudential policies per quarter, respectively. $SIZE$ is the natural logarithm of total assets, used as a measure of bank size, and $GRTA$ refers to the current year's

growth rate of total assets compared to the previous year. $INCODI$ is the income diversification index, calculated as $1 - \left(\frac{\text{Net interest income}-\text{Other operating income}}{\text{Operating income}}\right)$, where higher values indicate more diversified bank activities. The calculation of the income difference follows the definition of the indicator in the paper published by Laeven and Levine (2007). $NLTA$ is defined as (mortgage loan + consumer loan + corporate loan + other loans − bad debt reserve)/total assets. Lastly, Q_i represents quarterly dummy variables, where $Q_1 = 1$ if it is the first quarter, and similarly for Q_2, Q_3, and Q_4 for the second, third, and fourth quarters, respectively.

In 2014,the International Monetary Fund in 2014 has released the documents named Staff Guidance Note on Macroprudential Policy, which provides detailed guidance on the specific macroprudential tools that are available to address a given vulnerability, covering broad based tools, corporate sector tools, household sector tools, liquidity tools, and structural tools. We use this standard to build China's macroprudential policy database.The macro-prudential index in our paper is the sum of this four tools. https://www.imf.org/external/np/pp/eng/2014/110614.pdf

The reason why this paper only selects data for the past three years is to consider the availability of data. By 2019, the annual data that can be collected covers only 2011-2017, and each bank has 7 observations per indicator. In comparison, there is less data missing in 2015-2017.

Table 7: China Macro Prudential Policy Events , 2015:M1-2016:M2

Time	Policy content	Index	Policy Type
2015-01-01	The CBRC revised and issued the "Consolidated Supervision Guidelines for Commercial Banks," mainly clarifying the scope of consolidation, adding requirements for business coordination and risk management, and refining risk isolation. A 6-month transition period is set, effective from July 1, 2015.	1	broad based tools
2015-02-01	The CBRC revised and issued the "Leverage Ratio Management Measures for Commercial Banks," changing the credit conversion factors for certain off-balance-sheet items. It no longer requires 100% for all items but uses factors of 10%, 20%, 50%, and 100%. The leverage ratio of Chinese banks generally improved, and the revision did not increase capital requirements.	-1	broad based tools
2015-03-01	The PBOC, CBRC, and Ministry of Housing issued a notice reducing the minimum down payment for second home loans if the first loan is unpaid, lowering it from 60% to 40%. For those using the housing provident fund, the minimum down payment for a first home dropped from 30% to 20%, and for a second home from 30%.	-1	household sector tools
2015-04-01	The PBOC lowered the reserve requirement ratio for all deposit-taking institutions by 1 percentage point from April 20, 2015.	-1	liquidity tools
2015-08-01	The Ministry of Housing, Ministry of Finance, and PBOC lowered the minimum down payment for second home loans (if the first loan is paid off) from 30% to 20%.	-1	household sector tools
2015-09-01	The PBOC reduced the reserve requirement ratio for financial institutions by 0.5 percentage points.	-1	liquidity tools
2015-09-01	The PBOC and CBRC announced a reduction in the minimum down payment for first-time homebuyers from 30% to 25% in cities without purchase restrictions.	-1	household sector tools
2015-09-01	The PBOC reformed the reserve requirement assessment method, changing it from a point-in-time method to an average calculation method during the maintenance period.	-1	liquidity tools
2015-10-01	The PBOC reduced the reserve requirement ratio by 0.5 percentage points for financial institutions.	-1	liquidity tools
2016-01-01	The PBOC upgraded the dynamic reserve adjustment and desirable loan management system to a “Macroprudential Assessment System” starting in 2016.	1	broad based tools
2016-01-01	The PBOC extended the pilot program of macroprudential management for cross-border financing to include 27 financial institutions and firms in four free trade zones. Institutions and firms can conduct cross-border financing based on capital or net assets without prior approval.	1	broad based tools
2016-02-01	The PBOC and CBRC announced a minimum down payment of 25% for first-time buyers in cities without purchase restrictions, with a possible reduction of 5 percentage points. Households with outstanding first-home loans can now apply for commercial mortgages with a minimum down payment of 30%.	-1	household sector tools

Table 8: China Macro Prudential Policy Indicators Statistics , 2016:M2-2017:M12

Time	Policy content	Index	Policy Type
2016-02-01	The PBOC and CBRC announced a minimum down payment of 25% for first-time buyers in cities without purchase restrictions, with a possible reduction of 5 percentage points. Households with outstanding first-home loans can now apply for commercial mortgages with a minimum down payment of 30%.	-1	household sector tools
2016-04-01	The CBRC revised and officially released the "Internal Audit Guidelines for Commercial Banks," enhancing the comprehensiveness and effectiveness of the internal audit system, improving bank governance, and promoting stable operations.	1	broad based tools
2016-05-01	(PBOC) has decided to expand the pilot program for integrated macroprudential management of cross-border financing to financial institutions and enterprises nationwide. The PBOC can adjust parameters based on macroeconomic needs and assessment results to conduct counter-cyclical adjustments to cross-border financing, aligning it with economic conditions, repayment capacity, and international balance of payments, thereby controlling leverage and currency mismatch risks to prevent systemic financial risks.	1	broad based tools
2016-07-01	The PBOC has adjusted the assessment basis for RMB deposit reserves from end-of-period general deposit point values to the average daily balances during the assessment period. This reform optimizes both the numerator and denominator of the reserve requirement ratio calculation.	-1	liquidity tools
2016-09-01	The China Banking Regulatory Commission (CBRC) issued the "Comprehensive Risk Management Guidelines for Banking Institutions," establishing a robust risk management system and enhancing external supervision, which improves the banking system's ability to handle risks.	1	broad based tools
2017-01-01	Starting in Q1 2017, off-balance-sheet wealth management products will be included in the broad credit scope to encourage better risk management of off-balance-sheet activities.	1	broad based tools
2017-01-01	The PBOC clarified the requirements for centralized management of customer reserves by payment institutions, requiring a portion of these funds to be deposited in designated accounts, with an initial average deposit rate of about 20%. The goal is to safeguard customer funds and ensure payment institutions focus on their core business.	1	broad based tools
2017-04-01	The CBRC issued a notice to address regulatory gaps and improve regulatory effectiveness, focusing on key issues and risks faced by regulatory agencies and financial institutions to enhance operational standards.	1	broad based tools
2017-04-01	The CBRC also published guiding opinions on risk prevention in the banking sector, emphasizing the responsibility of financial institutions to manage risks and requiring them to develop practical implementation plans with strict self-inspection and corrections. Regulatory agencies are tasked with ensuring compliance and holding institutions accountable for any violations.	1	broad based tools
2017-05-01	The CBRC released the "Guidelines for Collateral Management in Commercial Banks," aimed at enhancing the risk-mitigating effects of collateral, controlling residual risks in mortgage transactions, and helping banks balance mortgage and credit loans to improve financial services to the real economy.	1	household sector tools