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Research on the Coordination of Bank Capital Adequacy Ratio and Monetary Policy——Based on panel data of 16 listed commercial banks in China

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ABSTRACT. *Capital adequacy ratio and monetary policy are important control measures for financial regulatory authorities and monetary authorities, respectively. Whether they can effectively cooperate greatly affects the effectiveness of monetary policy. This article selects the annual data of 16 listed commercial banks in China from 2003 to 2018, and builds a panel regression model to study the impact of capital adequacy ratio on the transmission of monetary policy. The results show that large state-owned commercial banks play a major role in the bank credit channel of monetary policy, and banks with higher capital adequacy ratios are more vulnerable to monetary policy. In addition, the external constraint of the minimum capital adequacy ratio will cause the monetary policy to have a multiplier effect when it is transmitted through credit channels. The multiplier effect of joint-stock commercial banks is much smaller than that of large state-owned banks. Therefore, financial regulatory authorities should fully consider the interference of capital adequacy ratio on monetary policy, strengthen policy coordination, and unblock the transmission mechanism of monetary policy.*

KEYWORDS: *capital adequacy ratio; monetary policy; policy coordination; bank credit; commercial banks*

1. Introduction

The statutory deposit reserve ratio is one of the commonly used adjustment tools

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of monetary policy and one of the main means used by regulatory authorities to manage the liquidity risk of the financial system. Capital Adequacy Ratio (Capital Adequacy Ratio) is the ratio of total capital of commercial banks to risk assets, which can reflect the ability of banks to use their own capital to bear losses. The regulatory authority sets the minimum capital adequacy ratio and the minimum core capital adequacy ratio to Restrain the excessive expansion of risk assets of commercial banks, thereby reducing the possibility of bankruptcy and failure of commercial banks. The two indicator systems of statutory deposit reserve ratio and capital adequacy ratio can effectively complement each other, and gradually become an important means of financial supervision. Monetary policy is the core macroeconomic control tool of the monetary authority, and its transmission path and policy effects will be affected by a variety of factors. With the deepening of financial supervision, the current monetary policy and commercial bank supervision implementation subject and policy objectives are different, but Intertwined with each other, it is increasingly showing more complex characteristics.

"Basel III" raises the core capital adequacy ratio of commercial banks to 7%, and sets a certain proportion of protective buffer capital and counter-cyclical buffer capital. These measures show that bank regulators have adopted capital adequacy ratio as an important standard for supervision and hand. The risk appetite, asset structure and credit policies of commercial banks will greatly affect the level of capital adequacy ratio. In order to meet the minimum capital requirements of financial regulatory authorities, they will adjust risk assets and reduce the size of credit. This has further led to the financing demand in the credit market being greater than the supply of funds, pushing up market interest rates and bringing a certain external shock to the traditional monetary policy transmission mechanism.

Examining the specific situation in China, the promulgation of the “Administrative Measures on the Capital Adequacy Ratio of Commercial Banks” heralds the regulatory authorities to begin to strictly restrict the capital adequacy ratio of commercial banks, which has greatly improved the stability and anti-risk ability of commercial banks . China is a financial system dominated by commercial banks. In this context, monetary policy will inevitably change in terms of channel and structure due to the strict constraints on the bank ’s capital adequacy ratio. Therefore, this article focuses on two issues: First, what role do large state-owned commercial banks and joint-stock banks play in the bank credit channels of monetary policy? Second, when capital adequacy ratio is used as a constraint, what effect will monetary policy have when it is transmitted through credit channels? In order to answer these two questions, this paper selects 16 listed commercial banks in China as research samples, and uses panel data model for empirical research. This is of great significance for further understanding the interactive relationship and joint influence between monetary policy and commercial bank regulatory policy.

2. Literature Review

The earliest research in Western countries focused on the impact of capital adequacy ratio on macroeconomics. With the deepening of research, academia began

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to study the role of capital adequacy ratio in the process of monetary policy transmission and the procyclicality of capital adequacy ratio. And many other aspects. Vanden Heuvel (2002)[1] constructed a forward-looking dynamic model, and analyzed the mismatch of deposit and loan maturity and the possibility that loan quality will deteriorate in the future. It was found that, under the condition that the capital adequacy level is subject to regulatory constraints, the credit supply of various commercial banks responds differently to monetary policy regulation. There is a large difference in the credit scale of banks with low capital adequacy ratios and banks with high capital adequacy ratios. Under loose monetary policy, commercial banks with high capital adequacy levels prefer to increase more credit supply. Kishan and Opiela (2000, 2006)[2] classified commercial banks according to the capital adequacy ratio. On this basis, they studied the reactions of commercial banks with different levels of capital adequacy ratio when facing monetary policy adjustments. Small commercial banks with low capital adequacy ratios are more sensitive to monetary policy adjustments. In addition, they found that after the emergence of capital supervision policies based on management risk, monetary easing policy had the largest positive impact on banks with high capital adequacy levels in terms of credit supply, while under the environment of monetary easing policies, low capital adequacy levels The number of banks that increase credit supply is very limited. Gambacorata (2004)[3] found that commercial banks with higher capital adequacy ratios have greater stability in the face of monetary policy or other macroeconomic shocks when studying Italian commercial banks.

Chinese academia has conducted many studies on the impact of capital adequacy ratio on the economy and credit supply, but the research on the relationship between capital adequacy ratio and monetary policy transmission is mostly theoretical analysis and relatively few empirical studies. Chen Longteng (2011)[4], when analyzing the relationship between monetary policy, capital adequacy ratio and risk-taking, believed that capital constraints have enriched the transmission channels of monetary policy and made it more diversified. Capital channels and risk-taking channels. Huang Xian (2012)[5] conducted an extended analysis of the IS-LM model under bank capital constraints and found that bank capital constraints would have an asymmetric effect on monetary policy by affecting bank credit channels. Joint efficiency is low. Lulu Wang (2013)[6] pointed out that the regulation of capital adequacy ratio belongs to the category of micro-prudential. The impact of capital adequacy regulation on credit, bank risk appetite, economic cycle and monetary policy transmission mechanism is essentially micro-prudential regulation and macroeconomic goals Embodiment of inconsistency. Wang Zhouwei and Wang Heng (2016)[7] set up a partial equilibrium system between banks and manufacturers from the perspective of bank heterogeneity, and found that large state-owned banks with large asset scales and high capital adequacy ratios and national joint-stock banks overall The level of liquidity creation is not significantly affected by monetary policy, and Wang Xin[8] (2018) has the same conclusion. Guan Yanfeng and Xu Qili[9] (2019) research shows that capital constraints of commercial banks are significantly related to credit risk. The higher the level of capital adequacy, the lower the credit risk. The impact of capital constraints and monetary policy on credit risk will have a "complementary effect."

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3. Research Design

3.1. Data Sources

This article has compiled the financial statements of 16 listed commercial banks (5 large state-owned banks and 11 national joint-stock banks and city commercial banks) in the Wind financial database from 2003 to 2018. The bank's year-end total loans, deposit reserve ratio and GDP growth rate were selected for research. The data on the legal deposit reserve ratio and GDP growth rate were derived from the People's Bank of China and the National Bureau of Statistics of China, respectively.

Table 1. Classification of sample banks

Types	Banks
Large state-owned commercial bank	Bank of China, Agricultural Bank of China, Industrial and Commercial Bank of China, Bank of Communications, China Construction Bank
National joint-stock banks and city commercial banks	Industrial Bank, Pudong Development Bank, Ping An Bank, Minsheng Bank, China Merchants Bank, China CITIC Bank, China Everbright Bank, Huaxia Bank, Bank of Beijing, Bank of Nanjing, Bank of Ningbo

3.2. Model settings

The specific expressions of the model in this paper are as follows:

$$Load_{i,t} = \alpha_i + \beta_1 MP_t + \beta_2 GDP_t + \beta_3 CAP_{i,t} + \beta_4 CAP_{i,t} MP_t + \varepsilon_{i,t}$$

Where *i* is the sample number of the research bank and t is the year.

In the model, Load represents the total amount of bank loans at the end of the year, expressed in logarithms. This variable can reflect the impact of capital adequacy ratio on the credit behavior of commercial banks, which is convenient for further analysis of the credit channels transmitted by monetary policy.

MP stands for statutory deposit reserve ratio, and uses the statutory deposit reserve ratio announced by the People's Bank of China as an agent variable for monetary policy. The increase in the statutory deposit reserve ratio represents tightening monetary policy, and its decrease represents loose monetary policy.

GDP represents the annual growth rate of gross domestic product. The introduction of this macroeconomic variable is to better examine the different responses of China’s large commercial banks and joint-stock banks to monetary policy during the economic cycle.

CAP indicates the capital adequacy ratio of various commercial banks.

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4. Empirical analysis

4.1. Unit root test

First, the unit root test was performed on the data. This article uses the LLC method to test the situation with the same root. Im-Pesarn-Skin method, Fisher-ADF method and Fisher-PP method were used to test the situation with different roots. The test results are shown in Table 2 below:

Table 2. Unit root test results

Testing method	GDP	Load	Dload	MP	Cap
LLC	-7.1847 (0.0000**)	-0.3104 (0.3781)	-10.7891 (0.0000**)	-14.7676 (0.0000**)	-25.7453 (0.0000**)
Im-Pesaran-Skin	-3.8021 (0.0001**)	4.7915 (1.0000)	-4.5383 (0.0000**)	-5.9845 (0.0000**)	-4.3669 (0.000**)
Fisher-ADF	67.4588 (0.0002**)	6.9629 (1.0000)	84.0319 (0.0000**)	106.933 (0.0000**)	58.9693 (0.0026**)
Fisher-PP	64.2125 (0.0006**)	14.7061 (0.9962)	110.614 (0.0000**)	104.377 (0.0000**)	61.6352 (0.0013**)

Note: "**" means rejecting the null hypothesis when the significance level is 5% (same below)

Table 2 shows that GDP growth rate, deposit reserve ratio and capital adequacy ratio are all stable time series. However, the total annual logarithmic loan does not pass the unit root test and is a non-stationary time series. After the first-order difference, the annual growth rate of total loans is a stable time series. So finally set the model to:

$$DLoad_{i,t} = \alpha_i + \beta_1 MP_t + \beta_2 GDP_t + \beta_3 CAP_{i,t} + \beta_4 CAP_{i,t} MP_t + \varepsilon_{i,t}$$

4.2 Panel data model estimation

After the stationary time series is obtained, the parameters of the model can be estimated. In this regard, the sample interval is divided into two categories: one is a large state-owned bank, which has obvious advantages in terms of operating scale, total assets, market share, etc. Bank of Communications. The other category is joint-stock commercial banks, including 11 other listed banks. Therefore, establish three panel data models: overall model, large state-owned bank model and joint-stock commercial bank model.

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Then the three models are tested for covariance and Hausman test to judge the form of each model. First, the model is set as a constant coefficient model, and the overall model, the large state-owned bank model and the joint-stock commercial bank model are estimated, and the sum of squared residuals of the three models is obtained. Secondly, the model is set to a variable intercept model, and Hausman test is performed. The test results are shown in Table 3 below:

Table 3. Hausman test results

Model	Statistics	P	Result
Overall model	11.8645	0.0149**	Reject
Large state-owned bank model	10.1274	0.0381**	Reject
Joint-stock commercial bank model	5.9272	0.2664	Agree

It can be seen from Table 3 above that the overall model and the large state-owned bank model pass the test at a significant level of 5%, so the original hypothesis is rejected and the overall model and the large state-owned bank model are set as fixed-effect variable intercept models. The corresponding P value of the joint-stock commercial bank model is 0.2664, which fails the Hausman test, so it is set as a random-effect variable intercept model. Finally, the model is set to a variable coefficient model to obtain the sum of squared residuals. After passing the Hausman test, covariance analysis was performed, and the results are shown in Table 4 below:

Table 4. Covariance results

	Overall model	Large state-owned bank model	Joint-stock commercial bank model
F_2	3.2748	2.0499	1.7502
Critical value of F_2	1.7468	2.0035	1.5914
F_1	2.7617	1.5836	1.2513
Critical value of F_1	1.3621	2.0731	1.7152
Result	Variable coefficient model	Variable intercept model	Variable intercept model

In summary, according to the results of the Hausman test, F_2 of the large state-owned bank model and the joint-stock commercial bank model are both greater than the critical value of F_2, and F_1 is less than the critical value of F_1. Model, the joint-stock commercial bank model is a random effect variable intercept model. F_1 and F_2 of the overall model are larger than their corresponding critical values, so they are set as fixed-effect variable coefficient models.

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The parameter estimation results of the overall model, the large state-owned bank model, and the joint-stock bank model are shown in Table 5 below, and the estimated results of α_i ^ *, which reflect the incremental difference in loans of large commercial banks in various countries, are shown in Table 6.

Table 5. Model parameter estimation results

Variable	Explained variable		
	Overall model	**Large state-owned bank model**	**Joint-stock bank model**
GDP_{it}	-0.5811** (-2.5018)	-0.9178*** (-3.3310)	-0.722^{6}*** (-3.4845)
MP_{it}	-0.4737** (2.1743)	-0.1196** (-2.7730)	-0.8582** (-2.1286)
CAP_{it}	0.0474** (2.2560)	0.0796** (2.6182)	0.0224** (2.1636)
$CAP_{it} \times MP_{it}$	-0.3926*** (-3.5696)	-0.6153** (-2.6663)	-0.1240** (-1.7287)
C	-0.1193* （-1.2549）	-0.7566** (-2.0054)	0.1703* (1.5386)

Note: "***", "**", "*" means significant at the levels of 1%, 5% and 10% respectively

Table 6. Differences in loan increments of state-owned commercial banks

Bank	α_i^*
Bank of China	0.0217
Construction Bank of China	0.0074
Industrial and Commercial Bank of China	-0.0491
Agricultural Bank of China	-0.0750
Bank of communications of China	0.0536

From the estimation results of the overall model, we can see that the GDP growth rate coefficient representing the change of the actual economic level is -0.5811 and it is significant at the 95% confidence level, which shows that the growth of credit scale will slow down when the economy is in an upward cycle. Bank credit has a reverse cyclical characteristic; the coefficient of the statutory deposit reserve ratio(MP_{it}) is -0.4737. When the central bank implements a tightening monetary policy, the total loan size of 16 listed commercial banks will increase for each unit of statutory deposit reserve ratio. Shrinking 0.4737 units, and the central bank's loosening of money to inject liquidity into the market will

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stimulate the impulse of bank credit expansion, indicating that bank loan channels exist in China's monetary policy; the capital adequacy ratio(CAP_{it}) coefficient is positive, The growth rate has a positive effect. As the bank's capital adequacy ratio increases, the size of its loans will also expand; in addition, the coefficient of the interaction term($CAP_{it} \times MP_{it}$) of the capital adequacy level and monetary policy is -0.3926, and the legal deposit reserve ratio(MP_{it}) The coefficient is -0.4737, both signs are the same and statistically significant. This means that the bank 's capital level has a multiplier amplification effect on monetary policy credit channels, and the greater the impact of monetary policy on commercial banks with higher capital adequacy ratios.

Comparing the model of large state-owned commercial banks and the model of joint-stock banks, the capital adequacy ratio coefficients of the former and the latter are 0.0796 and 0.0224, respectively. The impact of changes in capital adequacy level on large-scale state-owned commercial banks is much greater than that of joint-stock banks. At the same time, among the large state-owned banks, the multiplier effect of the capital adequacy ratio on the monetary policy credit channel is also greater than that of joint-stock banks. This shows that China's monetary policy bank loans are mainly transmitted through large state-owned banks. Under the condition of capital adequacy ratio constraints, large state-owned banks are more sensitive to changes in monetary policy. This is for two reasons: first, the system of joint-stock commercial banks is more flexible, and there are more ways and methods to cushion the impact of monetary policy. Secondly, large state-owned commercial banks dominate the Chinese credit market, so once large state-owned banks are exposed to external shocks, loan supply and demand will have a significant effect at the same time. This is consistent with the research results of Chen Weiping and Zhang Na.

5. Conclusions and policy recommendations

This article focuses on two issues: First, what is the impact of large state-owned banks and joint-stock banks on the credit channels of monetary policy? Second, under the influence of capital adequacy ratio, what effect does monetary policy have when it is transmitted through credit channels? In order to answer these two questions, this paper uses panel data model for empirical analysis based on the data of 16 listed commercial banks from 2003 to 2018. The results show that the bank loan channels for monetary policy exist in China and are mainly transmitted through large state-owned banks. Differences in capital adequacy levels will lead to a heterogeneous impact on the monetary policy banks 'loan channels to the banking sector. Large state-owned banks with high capital adequacy ratios are more sensitive to monetary policy, and monetary policies are more limited to shareholding systems with lower capital adequacy ratios. The external impact caused by commercial banks is relatively small. At the same time, in the face of the same capital constraints, the multiplier effect of credit channels transmitted by monetary policy through joint-stock commercial banks is much smaller than that of large state-owned banks.

In summary, this article puts forward three suggestions: First, to unblock the credit channels for monetary policy transmission, the supervisory department should

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strictly supervise and evaluate the business activities of commercial banks in accordance with the Basel Agreement III, improve the risk management system, and increase Great audit efforts, focusing on the disposal of risk assets by large state-owned banks, and regulating the behavior of joint-stock commercial banks to expand their asset scale through financial innovation. Second, weighing the regulatory methods of commercial banks and macro-control tools. Because the capital adequacy ratio has a multiplier amplification effect on the credit transmission channels of monetary policy, when the central bank injects liquidity into the market, the regulatory department should also minimize the capital adequacy of commercial banks. Rate requirements are taken into account. Third, speed up the innovation of the service mode of large state-owned banks, iron out the external impact of monetary policy by enhancing core competitiveness, and improve operational stability.

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