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Research on the Stress Test of Credit Risk in City Commercial Banks

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Abstract: ***City Commercial Banks are an important part of our banking system. In recent years, City Commercial Banks have gradually developed. But with the macroeconomic environment changes, City Commercial Banks are facing new challenges. The financial crisis in history make us recognized that risk management under normal market conditions is far from enough. We should take into account the impact of extreme market conditions on banks. Stress testing can measure the loss of banks when the "rare but possible" macroeconomic shocks happened. In practice, stress testing is getting more and more applications. This paper takes the credit risk of City Commercial Banks as the research object. Firstly, it expounds the importance of studying the change of credit risk in urban commercial banks under extreme scenarios. Secondly, it introduces the related concepts of credit risk and the theory of stress testing. Then, we choose the Wilson Model as the model of stress test, use the non-performing loan ratio as the dependent variable, and use the appropriate macroeconomic factor as the independent variable to establish the credit risk stress test model. The results show that the growth rate of GDP, loan interest rates and banking prosperity index have a great impact on the credit risk of commercial banks. Finally, this paper makes an empirical study on the credit risk of City Commercial Bank. We set different levels of stress scenarios, and test the changes of credit risk. Empirical results show that when City Commercial Bank received a macro pressure impact; the non-performing loan ratio will be a substantial rise. Accordingly, the credit risk increases. But through comparative analysis of the relationship between loan loss and there serves for non-performing loans, we found that the anti-pressure ability of China City Commercial Bank is strong. Even if in the severe impact of macroeconomic, the capital of China City Commercial Bank is still sufficient to compensate for the loss of credit risk losses.***

Keywords: City Commercial Banks, Credit Risk, Stress Testing, Non-Performing Loan Ratio, Wilson Model

1. Introduction

Urban commercial banks and other commercial banks together constitute our banking system, compared with other commercial banks; city commercial banks have their particularities. The predecessor of the city commercial bank was the urban credit cooperative established in the 1980s.In order to provide financial support for SMEs and promote the development of local economies, the Central Financial Supervision Department established the Urban Credit Cooperative. With the rapid development of the financial industry, many problems have been exposed in the risk management of urban credit cooperatives. In the mid-1990s, in order to reduce local financial risks, the central financial authority carried out reforms to urban credit cooperatives and established urban commercial banks. In recent years, the rapid development of city commercial banks has become an essential and important part of China's banking system. The development of city commercial banks has improved China's financial system, promoted the formation of a competitive landscape among commercial banks, and also improved the efficiency of financial market capital allocation. However, urban commercial banks are affected by their own history, system, and environment. Compared with other commercial banks, there are still large gaps in terms of operating strategies and risk management. Furthermore, as China's economy enters a new normal, the growth rate of GDP declines, and the price index rises rapidly, all these have brought new challenges to the operation of urban commercial banks. Various factors threaten the loan quality of city commercial banks and affect the credit risk level of banks. The credit risk of urban commercial banks cannot be ignored.

The outbreak of the subprime mortgage crisis in the United States in 2007 sounded the alarm for us. This crisis swept the globe and brought great damage to the global economy. The crisis also exposed the bank's deficiencies in credit risk management. Traditional credit risk measurement methods, such as the VaR method, can only measure the risk situation of banks under normal macroeconomic fluctuations, and cannot estimate losses in extreme scenarios such as the financial crisis. However, in the real financial market, there are often violent fluctuations. Therefore, stress tests have come into being. Stress testing can measure the losses of commercial banks in extreme scenarios such as economic crises. It is an effective supplement to the VaR method, so it is increasingly used in the risk management of commercial banks. The core idea of stress testing is to construct and simulate some extreme scenarios to measure the possible loss of credit assets when extreme scenarios occur.

China's urban commercial banks have weak risk management capabilities, and have relatively little investment in research and development of credit risk systems. Credit risk management systems need to be further improved. Most of the existing researches are based on the analysis of the impact of enterprises on the credit risk of city commercial banks, and there is little literature on the relationship between the dramatic changes in macroeconomics and the credit risk of city commercial banks. At the time of the economic crisis, all financial institutions, including city commercial banks, were not immune. Therefore, it is of great significance to conduct stress tests on urban commercial banks and study the changes in their credit risk levels under macroeconomic shocks.

2. Literature Review

The Basel Institute defines stress testing as a technical tool used to assess the loss of financial institutions to “extreme but likely” risks. The Basel Association has played a huge role in promoting the application of stress testing. In 2004, the Basel Association clearly stated in its regulatory requirements that commercial banks should conduct stress

tests on a regular basis and announce the results of their stress tests. In view of the requirements of the Basel Association, many scholars abroad have done a lot of research on the theoretical and empirical aspects of stress testing.

Vazquez et al. (2012) conducted a macro stress test on the credit risk of commercial banks based on scenario analysis. In this article, commercial bank credit is divided into 21 categories for analysis. Establish micro-models for pressure indicators and GDP growth rates, The results confirm that the non-performing loan ratio of commercial banks is negatively correlated with changes in the economic cycle. The research results also show that the cycle behavior of different types of loans is different, which provides a new idea for stress testing.

Petrella and Resti (2013) selected 90 EU commercial banks for macro stress testing, to assess whether the macro economy will affect the stock prices of commercial banks, empirical results show that macroeconomic shocks will affect bank stock prices, Therefore, the macro stress test can provide effective information for stock traders and can reduce the opacity of banks to a certain extent.

Cerutti and Schmieder (2014) pointed out that although stress testing has become an important tool for risk management and early warning, there are also weaknesses that cannot be ignored, that is, current stress tests are based on consolidated balance sheets without considering Potential risks posed by the structure. Therefore, a new framework is proposed to incorporate environmental and regulatory differences into the stress test system. Empirical research shows that regulation restricts capital flows and may significantly increase banks' capital requirements.

Savas and Bullent (2016) introduced a top-down main framework for macro stress testing. Based on this framework, macro stress tests were conducted on the Turkish commercial banking system. The results show that the growth rate of GDP, loan interest rates and exchange rates have a significant impact on the non-performing loan ratio of commercial banks. Therefore, in order to resist the impact of financial shocks on banks, commercial banks must maintain an adequate capital base.

Hasson et al. (2016) set up different stress scenarios to compare the changes in capital adequacy ratios between traditional banks and Turkish participating banks in different scenarios. The results show that under stress scenarios, the capital adequacy ratios of all banks will drop significantly. Compared with traditional banks, the capital adequacy ratio of participating banks has fallen even more severely. In addition, through comparison, it can be found that participating banks are more sensitive to changes in exchange rates.

The time for China to conduct stress tests is relatively late, and the technology is not very mature. It was not until the end of 2003 that China conducted its first stress testing practice. Industrial and Commercial Bank of China, Agricultural Bank of China, Construction Bank, Bank of Communications and Shenzhen Development Bank conducted stress tests on four aspects of risk, including interest rate risk, credit risk, exchange rate risk and liquidity risk. In 2007, the China Banking Regulatory Commission issued the Guidelines for Stress Testing of Commercial Banks, which standardized the concept and process of stress testing, and required China's commercial banks to complete the stress test within their prescribed time. Many domestic scholars also expounded the necessity of stress testing, and carried out the practice of stress testing for commercial banks in China.

SuWeihua and Guo Yuanai (2014) used the improved Credit Portfolio View model to conduct a stress test on the credit risk of China's banking industry based on quarterly data from 2004 to 2013.This paper uses Monte Carlo simulation technology to set different stress scenarios, and simulates the change of non-performing loan ratio of commercial banks when they encounter different macro stresses. The research results show that when encountering different levels of pressure shocks, the non-performing loan ratio of commercial banks will increase, but the increase rate is different. When encountering severe pressure shocks, the non-performing loan ratio of commercial banks will increase significantly. Finally, based on the results of the stress test risk assessment, the stress resistance of China's banking industry is analyzed. The results show that China's banking industry has a strong ability to resist risks.

Chen Huiqian (2015) pointed out that, in the context of China's new economic normal, the issue of credit risk has received increasing attention from relevant regulatory authorities. The article uses the non-performing loan ratio to measure the credit risk of commercial banks, and Logit substitutes the non-performing loan ratio. Then the seemingly unrelated regression and autoregression analysis was performed on the converted NPL ratio and pressure indicators. Using the method of macro stress testing, it is concluded that changes in macroeconomic factors have a significant impact on the NPL ratio of urban commercial banks.

Duan Yuejiao (2015) proposed that under the pressure of economic downturn, in order to maintain macroeconomic stability, the relationship between credit risk and macroeconomics is an urgent problem to be solved. The literature is based on the statistics of a large number of real data of small and medium-sized commercial banks in China, and establishes a stress test model to evaluate credit risks of small and medium-sized banks in China. By setting different stress scenarios and establishing regression models to measure the default rate of bank credit in different scenarios. The results show that under the downward pressure of the economy, the credit of small and medium-sized banks is inevitably affected. China's small and medium-sized commercial banks should follow market trends and strengthen credit monitoring.

Jiang Xiaobing and Ba Huan (2015) used China Agricultural Development Bank as an example for analysis. Similarly, the credit risk is measured by the non-performing loan ratio, which is converted into an intermediary index, and then multiple regression analysis is performed with the economic factors used to measure the rural economic development to

establish a model for measuring risk. Carry out autoregression on independent variables and use Monte Carlo simulation to set stress scenarios. The results of the stress test show that the increase in investment in fixed assets in agriculture, forestry, animal husbandry, and fisheries, the growth rate of central and local fiscal expenditures, and the number of new employment in the primary industry have a significant impact on the NPL ratio of the Agricultural Development Bank of China.

Shi Wenjun and Ye Delei (2016) selected 12 representative commercial banks for a macro stress test to analyze the sensitivity of China's commercial banks' credit risk to macroeconomic fluctuations. The research results show that changes in GDP growth rate, consumer price index, and broad money growth rate have a greater impact on the credit risk of China's commercial banks. Using the hypothetical scenario approach, two macroeconomic extreme scenarios have been constructed: the consumer price index has fallen sharply; and the GDP growth rate has fallen sharply. Under both pressure scenarios, the non-performing loan ratio of China's commercial banks has increased significantly.

3. Research Design

3.1Model Selection

At present, the models commonly used in international credit risk stress testing are Wilson model and Merton model. After comparative analysis, this paper uses Wilson model.

The Wilson model was proposed by the well-known risk management expert Wilson Thomas C. The Wilson model provides the theoretical basis and main framework for many international commercial banks' stress testing. The model comes in two forms, a simplified model and a complex model. The simplified model is a segmented test model, which is mainly used for the credit risk stress test of special loans, such as the stress test of personal consumer mortgage loans. The complex model is a centralized testing model that is mainly used for macroeconomic stress testing. It studies the changes in the default conditions of commercial bank credit assets under mild, moderate, and severe stress scenarios of macroeconomic factors.

The Wilson model consists of the following three formulas:

$$Y_t = \ln(\frac{PD_t}{1-PD_t}) \ (t = 1,2,3,...,N) \quad (3.1)$$

$$Y_t = \alpha_0 + \alpha_1 X_t + ... + \alpha_m X_{t-m} + \beta_1 Y_{t-1} + ... + \beta_n Y_{t-n} + \mu_t \quad (3.2)$$

$$X_t = b_0 + b_1 X_{t-1} + ... + b_p X_{t-p} + \theta_1 Y_{t-1} + ... + \theta_k Y_{t-k} + \varepsilon_t \quad (3.3)$$

Among them, Equation (3.1) represents the default rate, Because the default rate is a value in the interval (0,1), it is inconvenient to perform regression analysis. Therefore, it is necessary to perform Logit conversion on the default rate to obtain a new index so that it can take any value between (−∞, + ∞).From the formula, it can be concluded that there is a positive correlation between the default rate and the intermediary index, that is, the larger the value of, the larger the value of, and the worse the credit risk situation. Equation (3.2) is a multivariate linear regression equation. It is an intermediate variable obtained after Logit transformation. It is a macroeconomic factor that has a significant effect on the default rate. Linear relationship between macroeconomic variables of each order. Equation (3.3) is an autoregressive model of macroeconomic variables. In the actual situation, there will be a time lag in the impact of macroeconomic variables of each order on bank default rate. An autoregressive analysis was performed to exclude possible sequence correlations in the model.

3.2 Variable selection

The indicators used to measure the credit risk of commercial banks mainly include commercial bank loan default rate and non-performing loan rate. The default rate refers to the ratio of loans that the bank cannot recover to the total loan. In foreign stress testing practice, the default rate is generally used as an indicator to reflect the credit risk level of commercial banks. Taking into account the actual situation in China, the default rate is the internal data of the bank, it will not be publicly available, and the data is not available. Therefore, the non-performing loan rate was ultimately selected as a substitute for the default rate. In the selection of explanatory variables, this article first draws on the results of international stress tests and combines the actual conditions and macroeconomic conditions of China's commercial banks to initially select the GDP growth rate (GGDP) and loan interest rate (R), Money supply (M2), consumer price index (CPI), state housing prosperity index (RECI), exchange rate (ER), and bank prosperity index (YHY) as alternative explanatory variables.

3.3 Model construction

This article selects the quarterly data on the non-performing loan ratio of the city commercial banks from the first quarter of 2011 to the first quarter of 2017. The data comes from the China Banking Regulatory Commission. The non-performing loan ratio is then replaced by Logit to obtain new explanatory variables.

Compared with the original data, the year-on-year growth rate is more stable. Compared with the original data, the year-on-year growth rate is more stable, so when selecting the data, the GDP growth rate and the money supply growth rate are year-on-year growth rates; The Consumer Price Index, the State Real Estate Prosperity Index and the Banking Prosperity Index use monthly data, and quarterly data are obtained through geometric averaging. The exchange rate data uses the closing price of the last day of each month, taking the geometric average of the monthly data as the quarterly data. As for the interest rate, because there are one or more adjustments in the quarter, the method of weighting the average number of days is selected for processing.

4. Empirical Analysis

4.1 Descriptive statistics

Before carrying out the analysis, first logit transform the non-performing loan ratio of the city commercial bank to obtain the intermediate variable Y.It can be seen from the converted formula that the non-performing loan ratio and the intermediate variable Y have a positive relationship, that is, the larger the value of the non-performing loan ratio, the larger the value of the intermediate variable Y. This relationship can be intuitively reflected in Figure 4.1.

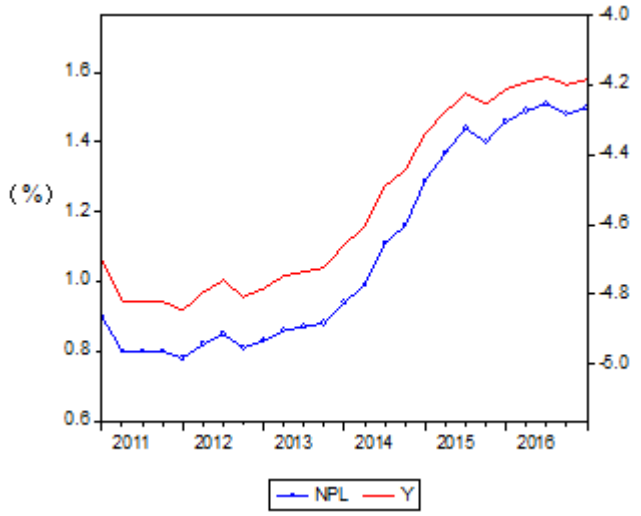

Figure 4.1: Comparison chart of city commercial banks' non-performing loan ratio and intermediary indicators

4.2 Variable Stationarity Test

Since the variables used in this paper are all time series, it is necessary to test the stationarity before establishing the model. This paper uses ADF unit root test to test its stability. The results of the unit root test are shown in Table 4.1 below.

Table 4.1: Stationary test results of each variable

variable	t statistic value	p-value	test result
Y	0.431644	0.9801	unstable
D(Y)	-4.622506	0.0014	smooth
GGDP	-2.856421	0.0655	unstable
D(GGDP)	-3.512231	0.0012	smooth
R	-2.409606	0.3653	unstable
D(R)	-2.774315	0.0078	smooth
GM2	-3.066385	0.1363	unstable
D(GM2)	-3.819692	0.0006	smooth
CPI	-1.750645	0.3917	unstable
D(CPI)	-4.592760	0.0001	smooth
RECI	-2.606852	0.1060	unstable
D(RECI)	-2.621237	0.0113	smooth
ER	0.228397	0.9968	unstable
D(ER)	-2.288801	0.0243	smooth
YHY	-1.072700	0.7093	unstable
D(YHY)	-4.411777	0.0001	smooth

As can be seen from the ADF test results in the table above, the p-value of the original sequence is significantly non-zero, so the null hypothesis is rejected, that is, the original sequences of the variables are non-stationary sequences. After first-order difference processing of the variables, unit root test is performed. From the corresponding t and p values in the ADF test results, it can be seen that at a significance level of 5%, the independent and dependent variables are stationary sequences after a first-order split processing, that is, all variables are Order single integer sequence. Therefore, there may be a co-integration relationship between the variables. You can use the original sequence for regression analysis and finally analyze the residual stability of the model regression results to determine whether there is a long-term equilibrium relationship between the variables.

4.3 Equation estimation

In this paper, Eviews software is used to build the model. In the process of modeling, first of all, considering the effects of macroeconomic changes on commercial banks with time-lag effects, the lagging term of the intermediary indicator Y is included in the regression equation for analysis. Therefore, before estimating the coefficients of the model, we must first determine the lag order of the intermediate index Y. The different lag terms of the intermediary index Y are included in the regression model, and the optimal lag order of the intermediary index Y is selected using the AIC (Akaike information criterion) information criterion and the SC (Schwarz Criterion) information criterion.

Table 4.2: Determination of the optimal lag order of the intermediate index Y

	0th order lag	First-order lag	Second-order lag	Third-order lag
AIC guidelines	-2.538946	-3.445483	-3.348898	-2.901199
SC guidelines	-2.197661	-3.052798	-2.953944	-2.504457

As can be seen from the above table, when the first-order lag variable of the intermediate index Y is introduced into the model, the AIC value and SC value of the equation are both minimum. According to the AIC criterion and the SC criterion, the smaller the AIC value and the SC value, the more appropriate the order of the lag. Therefore, in the estimation of the regression model, the first-order lag variable Y (-1) of Y is included in the regression equation.

Then, multiple regression analysis is performed on the intermediate indicator Y and the macroeconomic factors and the first-order lag variables of Y. The regression results are shown in Table 4.3.

Table 4.3: Estimated results of model parameters

Variable	Parameter Estimation	Standard error	t value	p-value
C	-0.199393	1.810366	-0.110140	0.9138
GGDP	-0.049238	0.037371	-1.317538	0.2074
R	0.102004	0.064811	1.573865	0.1364
GM2	-0.001274	0.006128	-0.207858	0.8381
CPI	0.001586	0.019163	0.082775	0.9351
RECI	0.004223	0.007384	0.571979	0.5758
YHY	-0.005484	0.007306	-0.750673	0.4645
ER	-0.012313	0.104326	-0.118024	0.9076
Y(-1)	1.015777	0.205461	4.943902	0.0002

As can be seen from table 4.3, even at the significance level

of 10%, the parameters of most variables in the model cannot pass the significance test, which indicates that not all variables can significantly explain the changes in non-performing loan ratio of urban commercial Banks, so some variables need to be removed from the model. The following step by step regression method will be adopted to eliminate the insignificant variables, and the results of step by step regression of macroeconomic factors with good explanatory power for the non-performing loan ratio are shown in table 4.4.

Table 4.4: Parameter estimation results of the model under the stepwise regression method

Variables	parameter estimation	Standard error	t-value	p-value
GGDP	-0.048034	0.018552	-2.589141	0.0180
R	0.113072	0.039195	2.884834	0.0095
RECI	0.003549	0.003034	1.169611	0.2566
YHY	-0.005333	0.003034	-1.757582	0.0949
Y(-1)	1.049148	0.095788	10.95283	0.0000

The results of the gradual regression show that the gross domestic product growth rate (GGDP), the benchmark lending rate for six months to one year (R), the national housing sentiment index (RECI), the banking sentiment index (YHY) and the first-order lag variable (Y 1) of the intermediate index have a significant impact on the non-performing loan ratio. However, the coefficient of RECI, the independent variable, cannot pass the t test even if the significance level is 10%. Therefore, it is necessary to remove the RECI and estimate the equation of the model again.

Table 4.5: Finally included in the list of regression equation variables

Variables	parameter estimation	standard error	t-value	p-value
GGDP	-0.033978	0.014263	-2.382279	0.0272
R	0.080611	0.027930	2.886153	0.0091
YHY	-0.006272	0.002953	-2.124117	0.0463
Y(-1)	0.941341	0.026302	35.78933	0.0000

After several tests, the four explanatory variables of the 6-month to 1-year GGDP benchmark lending rate (R) banking sentiment index (YHY) and the first-order lag variable (Y 1) of the intermediate index were finally determined. The regression equation 3.4 can be obtained from the above table, the R2 value of the equation is 98.45%, and the corrected R2 value is 98.22%, indicating that the fitting degree of the equation is very good.

$$Y = -0.0340GGDP + 0.0806R - 0.0063YHY + 0.9413Y(-1) \quad (4.1)$$

The ADF test of variables was carried out in the above paper, and the results showed that all variables were first-order hysteresis variables, and there might be a co-integration relationship, so the stability test of the residual sequence of the equation should be carried out. The results of the stationariness test show that the ADF value of the residual sequence is -7.261206, which is less than the critical value at 1% of the significance level. Therefore, the null hypothesis is rejected, that is, the residual differential sequence is classified as a stationary sequence. From this, it can be determined that there is a long-term equilibrium relationship between variables and there is no problem of pseudo-regression.

4.4 Setting of pressure scenarios

In this paper, scenario analysis is used to study the stress test of urban commercial Banks. Scenario setting is an important part of the stress test. Based on practical experience, there is likely to be a correlation between macroeconomic factors. In the empirical study of this paper, the GDP growth rate (GGDP) was selected as the sensitivity variable, and the correlation between GDP growth rate and other independent variables was obtained through regression analysis, so as to estimate the values of other independent variables. Finally, the predicted value of non-performing loan ratio was obtained through the stress test model, namely formula (3.1) and formula (3.4).

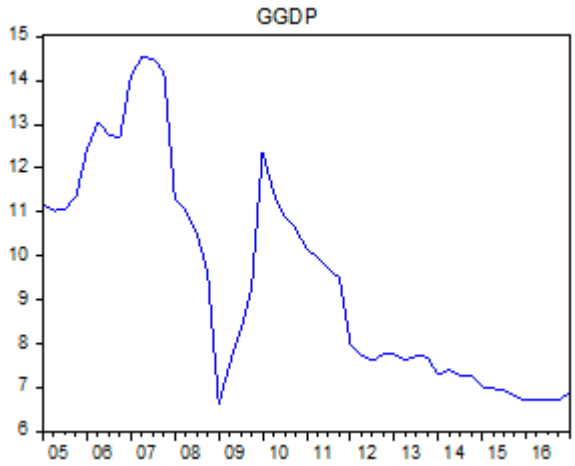

Figure 4.3: Broken line of GDP growth rate in recent 12 years

It can be seen from the above analysis that the stress scenario setting only needs to set the value of GDP growth rate. The GDP growth rate should be set in a reasonable and reasonable manner, neither too high nor too low. In view of this, this paper reasonably determines the stress test scenario according to the trend of GDP growth rate from 2005 to 2017. As can be seen from figure 4.3, the fastest growth period of China's GDP was the second quarter of 2007, reaching 14.54%. The slowest quarterly GDP growth was 6.62% in the first quarter of 2009. In addition, in recent years, especially since 2015, the growth rate of China's GDP has been continuously lower, below 7% for eight consecutive quarters.

On the premise of taking the above data into full consideration and combining with the changes in GDP growth rate during the economic crisis in foreign countries, the scenarios of the stress test were finally set as mild, moderate and severe.

Table 4.6 : Setting unit of GDP pressure scenario (%)

	Mild	Moderate	Severe
2017Q2	5.5	3.5	1.5
2017Q3	5	3	1
2017Q4	4.5	2.5	0.5
2018Q1	4	2	0

4.5 Analysis of Banks' pressure capacity

Firstly, linear regression analysis was conducted with GDP growth rate (GGDP) as the explanatory variable, and loan interest rate (R) and banking sentiment index (YHY) as the explanatory variables. In the process of regression, the explained variables and the lagging variables of the explained variables were included, and the appropriate explanatory variables were screened out by t value in the regression results and the value of goodness of fit R squared. The regression results show that there is a significant linear correlation between the loan interest rate R and the GDP growth rate (GGDP) and the first-order lag variable (R(-1)) of R, and the goodness of fit R squared and the adjusted R squared both reach above 95%, and the fitting effect of the equation is good. Banking prosperity index (YHY) has linear correlation with GDP growth rate and first-order lag variable of YHY, and both t value and R squared can pass the test. The results of the regression are as follows.

$$R = 0.1392GGDP + 0.8126R(-1) \quad (4.2)$$

$$YHY = 1.9419GGDP + 0.7903YHY(-1) \quad (4.3)$$

By using the correlation between independent variables, the specific pressure scenario set in the above paper is substituted into the equation, that is, the values of all independent variables under the pressure scenario can be obtained. The estimated value of each explanatory variable under different pressure shocks obtained above is substituted into the paper to obtain the multiple regression equation, namely equation (3.4), so as to obtain the value of the intermediate indicator Y. Then the value of the intermediate indicator Y is converted into Logit, and the value of the non-performing loan ratio can be obtained. The results are shown in table 4.7.

Table 4.7: Predicted non-performing loan ratio under different pressure scenarios

Sequential	mild		moderate		severe	
	Y	NPL (%)	Y	NPL (%)	Y	NPL (%)
2017Q2	-4.1797	1.51	-4.1098	1.61	-4.0399	1.73
2017Q3	-4.1442	1.56	-3.9927	1.81	-3.8704	2.04
2017Q4	-4.1159	1.60	-3.8744	2.03	-3.6818	2.46
2018Q1	-4.0298	1.75	-3.7357	2.33	-3.4783	2.99

It can be seen from the table that under the mild pressure impact, the non-performing loan ratio of urban commercial Banks reached 1.75%. Under the impact of moderate pressure, the non-performing loan ratio of commercial Banks reached 2.33%. In the face of severe macroeconomic shocks, the non-performing loan ratio reached 2.99%, almost double that of the first quarter of 2017 and approaching the level of the non-performing loan ratio during the financial crisis in 2008.

According to the calculation, the loan loss provision of urban commercial Banks in the first quarter of 2017 was 347.345 billion yuan, and the total loan amount was 1.0720 billion yuan. According to the non-performing loan ratio under different pressure scenarios estimated above, the specific amount of non-performing loans can be calculated. The results are shown in table 4.8.

Table 4.8: Amount of non-performing loans of urban commercial Banks under pressure scenario

	Non-performing loan ratio（%）	Non-performing loan amount（billion）
Mild	1.75	1876
moderate	2.33	2497.76
severe	2.99	3205.28

It can be seen from the above table that, even under severe stress shocks, the loan loss provisions of urban commercial Banks can cover non-performing loans, indicating that urban commercial Banks can withstand the impact of macroeconomic changes under extreme circumstances. The reasons are the following: first, city commercial Banks, compared to the state-owned commercial Banks and joint-stock Banks assets on a smaller scale, the strength is weak, therefore, in daily management, city commercial Banks will have larger proportion of loan loss preparation, for a long time, city commercial Banks set aside coverage to almost four percentage points higher than state-owned Banks and joint-stock Banks. Second, the business scope of urban commercial Banks is limited by the region and may be more influenced by the local economy rather than sensitive to the changes in the macro economy.

5. Conclusion

In this paper, the credit risk of city commercial Banks is taken as the main body, and the stress test is applied to study the changes of them under the severe impact of macro-economy. Firstly, this paper expounds the importance of credit risk management in urban commercial Banks under the new normal of economy. Secondly, the model of the stress test is determined, and the explanatory variables and explained variables required in the model are selected to estimate the regression model. Finally, the obtained model is applied to conduct empirical analysis on the credit risk of urban commercial Banks. An explanatory variable is selected as the sensitivity variable, and different stress scenarios are set for it. The regression model is used to test the change of credit risk of urban commercial Banks under different pressure shocks. Through empirical analysis, it can be concluded that the impact of macro-economy will indeed have a certain impact on the credit risk level of urban commerce. When the macroeconomic environment deteriorates, the non-performing loan ratio of urban commercial Banks will increase and the credit risk will correspondingly increase. Specifically, the main conclusions of this paper are as follows.

First, macroeconomic changes will have an impact on the level of credit risk of city Banks. From the results of the regression, the macroeconomic factors that have a greater impact on the credit risk of urban commercial Banks are GDP growth rate, loan interest rate and banking prosperity index. GDP growth rate and banking prosperity index are negatively correlated with non-performing loan ratio, while loan interest rate is positively correlated with non-performing loan ratio, which is in line with the actual economic significance. In addition, the empirical results of this paper take into account the correlation between macroeconomic factors, and the results show that GDP growth rate will have an impact on loan interest rate and

banking sentiment index. Therefore, the GDP growth rate is only set when the stress scenario is set in this paper, and the value of loan interest rate and banking sentiment index can be calculated.

Second, China's urban commercial Banks have a strong ability to resist the impact of macro pressure. Under severe pressure, although the non-performing loan ratio will be greatly increased, due to the high provision coverage of urban commercial Banks, the non-performing loan reserve can completely cover the non-performing loans, indicating that urban commercial Banks have strong risk resistance.

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