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Research on the Impact of Digital Financial Inclusion on Credit Risk of Ningbo Banks

Chunhua Huang[a, *], Xiaoxuan Hong[b]

School of Economics, Guangzhou College of Commerce, Guangzhou 511363, China

[a, *]393845766@qq.com, [b]1102363780@qq.com

Abstract

The booming development of digital inclusive finance in China has brought unprecedented opportunities to commercial banks, but also faces serious challenges. The increasing competition in loans, deposits and intermediate business of commercial banks has led to the rising cost of capital and a significant decline in their profitability, which in turn has triggered a series of credit risks. The article centers on the micro subject of city commercial banks, and empirically analyzes the impact of the development of digital inclusive finance on the credit risk level of Bank of Ningbo, taking Bank of Ningbo as an example. Through the empirical analysis, it provides some suggestions on credit risk prevention and control for the regulatory authorities and the bank itself, helps city commercial banks to complete digital transformation and upgrading, improves the digital and intelligent level of risk management, promotes sound and sustainable development, realizes the sustainability of high-quality development, and steadily moves forward to the prospect of becoming a first-class comprehensive financial service provider.

Keywords

Digital Transformation; Digital Inclusion; Credit Risk.

1. Background and Significance of the Study

It has been more than ten years since the emergence of inclusive finance, and the state has always attached importance to the development of inclusive finance, formulated policy support and supervision system, and constructed an increasingly perfect inclusive financial service system. With the development of digital technology, the digitization of inclusive finance has brought new changes to the type of inclusive finance business and opened up new financing paths. 2023 Bankers' Financial Innovation Forum, held in Beijing on October 17, 2023, also centered on the topic of "Integration and Innovation of Digital Technology and Inclusive Finance" and conducted a rich discussion on the topic of "Integration and Innovation of Digital Technology and Inclusive Finance". The "2023 Bankers' Financial Innovation Forum", held in Beijing on October 17, 2023, has also carried out rich discussions on the topic of "Integration and Innovation of Digital Technology and Inclusive Finance", pointing out the significance of the new model of innovative digital inclusive finance in alleviating the contradiction between supply and demand.

Taking Bank of Ningbo as an example, the article analyzes the credit risk influencing factors of digital inclusive finance on Bank of Ningbo by establishing a multiple regression model, with a view to enriching the relevant research on the credit risk management of digital inclusive finance on city merchant banks, and at the same time, helping the regulators to timely identify the problems, strengthen the financial supervision, establish a regulatory system that is more adapted to the characteristics of digital inclusive finance, improve the financial system, and provide the real economy with better services.

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2. Literature Review

Many foreign scholars believe that digital inclusive finance will exacerbate bank credit risk to a certain extent. Ozil (2018) points out that digital inclusive finance will increase competition among banks and force them to improve their financial services[1]. Vo et al (2021) state that the inclusion of digital inclusive finance increases the large savings deposits of rural residents and raises the income from loan finance business[2] Chinoda et al (2023) study the impact of digital financial inclusion and bank competition on bank stability in Sub-Saharan Africa over the period 2014-2020 and the results show that digital financial inclusion is significantly positively associated with bank stability (z-score) and significantly positively associated with non-performing loans[3] .

Domestic scholars have not reached a consensus on the study of digital financial inclusion on the credit risk of urban commercial banks. Some scholars are more optimistic that the development of digital inclusive finance is positive and can help commercial banks cope with risks under certain conditions: Wu Haoyang (2023) believes that micro and small enterprises, disadvantaged customers, etc. supported by the background of digital inclusive finance share the credit risk for the bank, reduce the concentration of loans, and make the bank's overall credit risk reduce[4] . Ying Hu (2019) found that banks in digital technology development enhanced payment and credit management[5]. Feng Si-Hsien (2019) found that healthy competition among banks is significantly more intense in the context of digital financial inclusion, and banks' profits are improved while making costs lower[6] . Other scholars advocate that the development of digital financial inclusion has a negative impact. Jin Hongfei (2020) argues that fintech increases the degree of information asymmetry in the long-tail customer group, which negatively affects banks' risk response[7]. Yu Xiaoyan (2022) argues that about 72% of banks' business development is achieved by increasing deposit costs and developing non-interest business, which in turn exacerbates credit risk[8] . Li Cangshu and Shen Yan (2019) argued that new corporate risks can have an impact on the uncertainty of financial markets in the digital economy, so it is necessary to strengthen the construction of early warning and risk mitigation mechanisms[9] . Guo Pin and Shen Yue (2019), on the other hand, argue that digital finance triggers the bank price dividend mechanism leading to increased bank competition, which raises risk[10] .

3. Theoretical Foundations and Hypothesis Formulation

3.1. Theoretical Basis: Long Tail Theory

Long Tail Theory was firstly proposed by Chris Anderson in 2004, he believed that in the past, people paid too much attention to a few so-called "head" those important people or things, but neglected the "tail" needs of more people. In the Internet era, the overall benefit of focusing on the "tail" is even greater than that of the "head", i.e., the long-tail market plays an important role. The more intense the competition in a market, the greater the role of the latter.

The role of the "long tail" theory has been further strengthened by the rapid development of digitally inclusive finance, which on the one hand has given rise to a variety of financial service platforms that can meet the individual investment needs of "tail" customers. On the other hand, technological developments have greatly reduced costs and allowed financial institutions to expand their business scope.

3.2. Rationale: Information Asymmetry

George Akerlof (1970) describes the phenomenon of "bad money driving out good money" in the used car market as a result of significant differences in the quality of information between buyers and sellers, and argues that there can be no "winners" in the used car market, which is referred to as information asymmetry[11]. This is called information asymmetry.

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In the deep logic of the financial sector, banks that are cautious about risk and pursue sound growth optimize the allocation of resources by setting lower lending rates, which not only help to reduce potential losses, but also improve the quality of assets held by banks to some extent. However, this phenomenon has led to an unequal distribution of financial services, exacerbated wealth and income disparities and, to some extent, distorted market mechanisms, limiting the development of inclusive finance.

3.3. Hypothesis Development

Under the government's support and call for financial inclusion, Bank of Ningbo, as a local city commercial bank, has followed the government's policy of paying more attention to "tail customers", relying on its geographical advantages to develop personal consumption loans and retail loans for high-quality customer groups, and to increase the number of personal consumption loans, with personal consumption loans providing higher spread income, becoming an important pillar of its revenue. The personal consumption loan business, which provides higher spread income, has become an important pillar of its revenue, and the company has tilted its business to retail customers, which is mainly targeted at universal customers, i.e., micro-enterprises and residents, in order to reduce the risk of defaults brought about by information asymmetry.

Based on the above theories, the following hypotheses are proposed in this paper:

H0: The development of digital inclusive finance increases the risk of nonperforming loan generation in Bank of Ningbo.

4. Empirical Analysis of Digital Financial Inclusion on Credit Risk of Ningbo Banks

4.1. About Bank of Ningbo

Bank of Ningbo is a joint-stock commercial bank with independent legal personality established on April 10, 1997. listed in 2007 as one of the first listed city commercial banks in China, its business is mainly concentrated in the Yangtze River Delta region, with strong lending support for small and micro enterprises, manufacturing and green finance, etc. Bank of Ningbo is one of the city commercial banks in China with better asset quality, higher capital adequacy ratio, and lower non-performing loan ratio. Bank of Ningbo is one of the banks with better asset quality, higher capital adequacy ratio, stronger profitability and lower non-performing loan ratio among China's city commercial banks. Bank of Ningbo is a commercial bank that has maintained a profit growth rate of more than 15% and a non-performing rate of less than 1% for 10 consecutive years.

A comparison of the 2023 credit risk indicator data of five banks with equal regional characteristics in the Yangtze River Delta region found that (Figure 1 below), Bank of Ningbo's non-performing loan ratio, deposit-to-lending ratio, net interest margin, and capital adequacy ratio all have certain regional advantages for city commercial banks.

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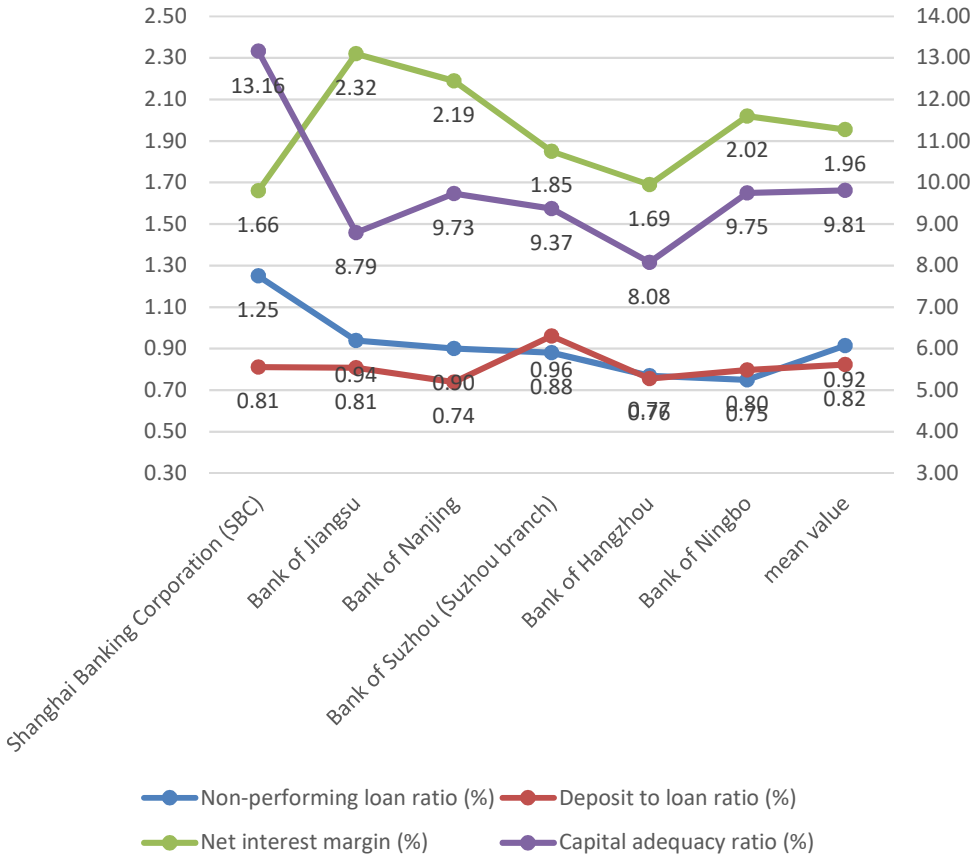

Figure 1. Credit Risk Indicators of Major City Banks in Yangtze River Delta Region, 2023
Source: Data from annual reports of major banks

4.2. Model Setup

This paper focuses on the impact mechanism of the development of digital inclusive finance and the credit risk of Bank of Ningbo, and selects the index data and non-performing loan ratio of Bank of Ningbo for a total of 11 years from 2011 to 2022 as the research samples, and the analyzing tool is EViews9 software.

4.3. Variable Selection and Data Sources

4.3.1. Data Sources

Based on the Peking University Digital Inclusive Finance Index Report, this paper selects the "Digital Inclusive Finance Development Index" of the place where Bank of Ningbo is located as the basis, reflecting the development of digital inclusive finance in local cities. The microfinance data of Bank of Ningbo is mainly obtained from the annual report of Bank of Ningbo, partly from Snowball.com, and the macroeconomic indicators are obtained from the China Statistical Yearbook.

4.3.2. Selection of Variables

The main financial data of Bank of Ningbo from 2011 to 2020 is selected as the time series data as the research sample, mainly selected from the annual report published by the bank, and the experimental process is mainly through the multiple linear regression model to test how the digital financial inclusion affects the credit risk of Bank of Ningbo, and the stability test of the time series is carried out through the goodness-of-fit test and other methods.

(1) Explained Variables

Based on reviewing the findings of previous scholars, it is generally recognized that the various indicators for measuring the risk tolerance of commercial banks include non-performing loan

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ratio, capital asset ratio, etc., this paper draws on the research of scholars such as Guan Yanfeng (2018) and chooses the non-performing loan ratio (NPL) as the explanatory variable[12] . The non-performing loan ratio (NPL) is used as a measure of credit risk, which is denoted by Y.

(2) Explanatory variables

In this paper, the inclusive finance index is selected as an explanatory variable. The index is compiled by the Digital Finance Research Center of Peking University and Ant Group. With its unique design and rigorous data analysis, this index can accurately map the specific practices and effectiveness of promoting the development of inclusive finance across China. Therefore, the DIF index is set as a measurement index and expressed as X1.

(3) Control variables

Cost-income ratio (X2): the costs that a bank must incur to obtain a certain level of operating income. The higher the value of this indicator, the higher the proportion of the bank's operating costs, and vice versa. This indicates that by controlling the operating costs of commercial banks and widening the scope of credit, the non-performing assets of commercial banks can be effectively reduced.

Capital Adequacy Ratio (X3): the final solvency of the bank in terms of the capital it has versus the assessed risky assets. In order to achieve higher profits, urban commercial banks will use small capital to operate large amounts of debt assets resulting in risk.

Provision Coverage Ratio (X4): The appropriateness of adequate loan loss provisioning can assess the quality of the bank's assets and set higher requirements. If the provision coverage ratio of non-performing loans is high, it indicates that urban commercial banks are well prepared to defend against credit risks, so it will reduce the rate of non-performing loans.

GDP growth rate (X5): If the economic development of the region where the city commercial bank is located is more stable, then the operation of the city commercial bank in that region will also be more robust. This is because macroeconomic fluctuations directly affect the profitability of local enterprises, and therefore their ability to repay loans. When the economy is unstable, the operation of enterprises is affected, resulting in large non-performing loans for banks.

(4) Data processing

Due to the large order of magnitude difference between the data of the explanatory variable Y and the explanatory variable X1, and the control variables X2-X5, in order to minimize the possibility of the existence of heteroskedasticity, the above variables are taken in logarithmic terms and the original correlations between the variables and the variables are left unaltered.The Y treatment is denoted as LNY, and the X1-X5 treatments are denoted as LNX1, LNX2, LNX3, LNX4, and LNX5.

Table 1. Summary of variable indicators

Variable type	variable name	variable symbol	Variable Definition
explanatory variable	Non-performing loan ratio NPL	LNY	Non-performing loans/loan balance*100%
explanatory variable	Digital Inclusive Finance Index DIF	LNX1	Peking University Digital Inclusive Finance Index
control variable	Cost to Income Ratio CIR	LNX2	Operating expenses/operating income*100%
	Capital Adequacy Ratio CAR	LNX3	Net capital/total risk-weighted assets*100%
	Non-performing loan provision coverage ratio PC	LNX4	Sum of general + specific + special provisions/ substandard + doubtful + loss loans
	GDP growth rate GOV	LNX5	Current GDP/GDP of the base period*100%

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4.3.3. Descriptive Statistics

Table 2. Results of descriptive statistics

variant	average value	(statistics) standard deviation	minimum value	maximum values
Y (NPL)	0.81	0.79	0.92	0.68
X1(DIF)	293.10	291.45	447.19	77.39
X2 (CIR)	35.11	34.54	37.96	32.07
X3 (CIR)	14.21	14.85	15.65	12.06
X4 (PC)	399.29	422.34	525.52	240.74
X5 (GOV)	7.10	7.68	9.00	3.10

4.3.4. Model Construction

(1) Model design

1)Smoothness test: the original hypothesis: the existence of a unit root, the existence of a unit root indicates that the series is not smooth; it may lead to the emergence of pseudo-regression phenomenon. It may indicate that the relationship between the variables is not necessarily a true causal relationship, but only the overlap of trends over time, using the ADF test, the basic model is as follows:$Y_t = \gamma Y_{t-1} + \mu_t$

When there is autocorrelation in the random disturbance term μt , the model deforms as follows:

$$Y_t = \gamma Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

2) Conducting cointegration tests: using the E-Q test

In the first step, the equation for the cointegration regression is as follows: $Y_{1t} = \alpha + \beta_2 Y_{2t} + \cdots + \beta_k Y_{kt} + \mu_t$

The formula for the residual sequence can be calculated as$e_t = Y_{1t} - (\hat{\alpha} + \hat{\beta}_2 Y_{2t} + \cdots + \hat{\beta}_k Y_{kt})$.

In the second step, the smoothness test ofe_t is performed.

Step 3, Conclusion: if the residual series e_t has smoothness, it can show that there is a cointegration relationship between the variables.

3) Build a VAR model. Determine the lags of the model and then test the stability of the VAR model.

(2) Modeling with OLS

$$LNY = C + \beta_1 LNX1 + \beta_2 LNX2 + \beta_3 LNX3 + \beta_4 LNX4 + \beta_5 LNX5 + e \quad (2)$$

The model parameters are estimated using the least squares method, where C: the constant term, theβ_1 -β_5 : the value to be valued, -e : the residual term.

According to the table above, the goodness of fit of the regression equation R2 =0.9330 indicates that the above model has a good explanatory relationship for the degree of explanation, the t-test of LNX1, LNX3 and LNX4 is significant at the 5% level and the sign of the coefficients is consistent with the economic reality; the F-statistic is 16.7, P=0.001<0.05, the F-test is significant indicating that the variables that are united together have significant effects on the LNY has a significant effect and it is concluded that the equation is valid as a whole.

The lack of significance of LNX2 and LNX5 indicates that these two variables do not have a significant influence relationship and do not affect the dependent variable in a very significant way within the defined sample distribution, so they fail the significance test in the subsequent

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regression analysis. However, in a conventional scenario, this control variable is retained in the model even though it is not significant, considering that this variable is indeed an important factor influencing the dependent variable.

Table 3. Regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.313633	0.996038	2.322836	0.0592
LNX1	0.169838	0.057214	2.968452	0.0250
LNX2	0.304155	0.288904	1.052791	0.3330
LNX3	-0.507406	0.152673	-3.323482	0.0159
LNX4	-0.188346	0.094430	-1.994563	0.0193
LNX5	0.037442	0.041856	0.894536	0.4055
R-squared	0.933015	Mean dependent var		-0.212584
Adjusted R-squared	0.877194	S.D. dependent var		0.092561
S.E. of regression	0.032437	Akaike info criterion		-3.712183
Sum squared resid	0.006313	Schwarz criterion		-3.469730
Log likelihood	28.27310	Hannan-Quinn critter.		-3.801948
F-statistic	16.71441	Durbin-Watson stat		1.822153
Prob(F-statistic)	0.001826			

4.3.5. Empirical Analysis

(1) Unit root test

Time data is unsteady data, so before processing the information data, a unit root test must be done to screen out the stable data. Its initial assumption is the existence of unit root. In EVIEWS operation, AIC, SC, HQ minimum test is utilized to select the intercept term and trend.The result of ADF test is shown below:

Table 4. ADF test results

variant	ADF test	Test value at 5% significance level	P-value	Test results
LNY	-3.1103	-3.9333	0.1521	ıeven
LNX1	-6.5831	-3.9333	0.0017	ıoothly
DLNY	-2.8167	-1.9823	0.0281	ıooth**
DLNX1			0.0026	ıooth**
DLNX2			0.0002	ıooth**
DLNX3			0.0028	ıooth**
DLNX4			0.0307	ıooth**
DLNX5			0.0001	ıooth**

The results show that only the sample LNX1 is smooth in the initial state, and the others are non-smooth. Therefore, to ensure the high accuracy and stability of the model developed, further tests on its first-order difference are needed.

The first-order difference series of the explanatory variables is stable at the 5% significance level, indicating that the test induced by the first-order difference series does not cause the original series to be non-stationary; from the result of the smoothness test, $P<0.05$, which negates the original hypothesis, so this series is a single-integrated series of the same order, which meets the requirements of further cointegration tests.

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(2) NCointegration test

In the first step, since the regression results of LNX2 and LNX5 were not significant, we chose to exclude the X2 and X5 variables, and regressed the same-order single-integer original series to generate the residual series, and the results are as follows:

Table 5. Cointegration regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.505368	0.114177	13.18451	0.0000
LNX1	0.084859	0.059348	-1.429859	0.2121
LNX3	-0.288130	0.129965	-2.216984	0.0774
LNX4	-0.074300	0.037537	-1.979390	0.1047
E1	1.000000	0.140162	7.134607	0.0008
R-squared	0.988595	Mean dependent var		-0.189090
Adjusted R-squared	0.979470	S.D. dependent var		0.078133
S.E. of regression	0.011195	Akaike info criterion		-5.839840
Sum squared resid	0.000627	Schwarz criterion		-5.688548
Log likelihood	34.19920	Hannan-Quinn critter.		-6.005808
F-statistic	108.3464	Durbin-Watson stat		2.928092
Prob(F-statistic)	0.000048			

The residual sequence e1= LNY-1.5053-0.0848 LNX1+0.2881 LNX3+0.0743 LNX4 is generated from the results

The results of the ADF unit root test are presented in the table below:

Table 6. ADF test results for e1

Type of test (c,t,k)	ADF value	1% threshold	5% threshold	10% threshold	P-value
(0,0,0)	-2.763597	-2.792154	-1.977738	-1.602074	0.0106

From the above test results, P=0.0106<0.05, so the original hypothesis that "the series has a unit root" can be disproved at the 5% level of significance, that is, e1 is a stable series, which can be determined that LNY, LNX1, LNX3, LNX4 is a cointegration of the first order, and there is a long period of stable equilibrium. a long time stable equilibrium. From the empirical analysis, it can be seen that there is a relatively obvious positive correlation between LNY and LNX1.

(3) Error correction model

From the results, it can be seen that in the short run if an external shock is received that is the relationship between the variables is shifted from the long run trajectory, there will be a proportional strength of 0.95 per year is the relationship between the variables is pulled back.

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Table 7. Error correction results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNX1	0.185540	0.054246	3.420334	0.0111
DLNX3	-0.513730	0.101874	-5.042806	0.0015
DLNX4	-0.153812	0.133154	-1.155141	0.0220
e1(-1)	-0.952308	0.448890	-2.121472	0.0716
C	-0.018887	0.013026	-1.449922	0.1904
R-squared	0.967806	Mean dependent var		0.008907
Adjusted R-squared	0.811152	S.D. dependent var		0.072463
S.E. of regression	0.031490	Akaike info criterion		-3.803003
Sum squared resid	0.006941	Schwarz criterion		-3.658314
Log likelihood	24.91652	Hannan-Quinn critter.		-3.894209
F-statistic	15.31751	Durbin-Watson stat		2.246601
Prob(F-statistic)	0.001852			

(4) Multiple covariance test

A test for multicollinearity was conducted using VIF (Variance Inflation Factor) to assess whether correlations between the variables in the model would result in disturbances in the overall trend of the data.

Table 8. VIF test results

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.992092	11314.95	NA
LNX1	0.003273	1171.600	9.062642
LNX3	0.023309	1868.117	2.494985
LNX4	0.008917	3602.475	9.682963

Based on the results of the tests, we can find that all the VIF test results are less than 10, and this significant numerical difference indicates that our datasets are independent and do not suffer from covariance problems serious enough to affect the whole analysis. This means that even though our model contains multiple independent variables and one dependent variable, they do not interact with each other, thus ensuring the reliability and validity of the findings.

(5) Autocorrelation test

Firstly, the p-value derived from the LM test reveals the strength and direction of the correlation between the variables According to the LM test results, the autocorrelation was found to be P=0.03<0.05, which rejects the original hypothesis and indicates the existence of autocorrelation with second order lag.

Table 9. LM test results

F-statistic	2.747608	Prob. F(2,4)		0.1775
Obs*R-squared	6.944823	Prob. Chi-Square(2)		0.0310

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Next, a serial correlation correction is performed (generalized least squares GLS).
After correction by GLS the results show that D.W=2.08 Checking the table shows that dl=0.658, du=1.864, du<D.W<4-dl, which indicates that the equation is not autocorrelated.

Table 10. Sequence-related corrections

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.147513	0.620676	3.459960	0.0258
LNX1	0.169630	0.035349	4.798685	0.0087
LNX3	-0.682402	0.098771	-6.908904	0.0023
LNX4	-0.146139	0.049101	-2.976318	0.0049
AR(1)	-0.328782	0.293186	-1.121411	0.3249
AR(2)	-1.000000	0.543022	-1.841547	0.1393
R-squared	0.982778	Mean dependent var		-0.212584
Adjusted R-squared	0.952640	S.D. dependent var		0.092561
S.E. of regression	0.020143	Akaike info criterion		-0.727693
Sum squared resid	0.001623	Schwarz criterion		-0.404422
Log likelihood	12.36616	Hannan-Quinn criter.		-0.847379
F-statistic	32.60931	Durbin-Watson stat		2.082508
Prob(F-statistic)	0.002269			

(6) Heteroscedasticity test: according to the WHITE test results:
The WHITE test showed P=0.1557>5%, accepting the original hypothesis, indicating that there is no heteroscedasticity.

Table 11. white test results

Heteroskedasticity Test: White			
F-statistic	2.408802	Prob. F(5,6)	0.1573
Obs*R-squared	8.009756	Prob. Chi-Square(5)	0.1557
Scaled explained SS	0.940130	Prob. Chi-Square(5)	0.9672

(7) VAR modeling

Table 12. VAR modeling results

VAR Lag Order Selection Criteria						
Endogenous variables: LNY LNX1						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	28.52562	NA	9.46e-06	-5.894583	-5.850755	-5.989163
1	29.38992	1.152399	2.00e-05	-5.197760	-5.066277	-5.481500
2	40.12878	9.545656*	5.63e-06*	-6.695285*	-6.476147*	-7.168185*

VAR modeling using a system consisting of two variables, LNY and LNX1, employs an approach that combines several criteria to accurately determine the lag order of the model. First, the fit

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of the model and its explanatory power of the data were assessed based on the scores of these criteria by examining several important metrics such as linear regression (LR), free preprocessing error (FPE), auto-informativeness (AIC), smoothing coefficient (SC), and Gaussian component (HQ).

From the AIC, SC minimization criterion, the optimal lag of the VAR model is 2 and has 4 characteristic roots.

The fact that each of the characteristic roots in the model is inside the unit circle confirms that the VAR model has passed the stability test criteria we have set. That is, the model exhibits sufficient stability to be considered reliable. The results of the test are shown below:

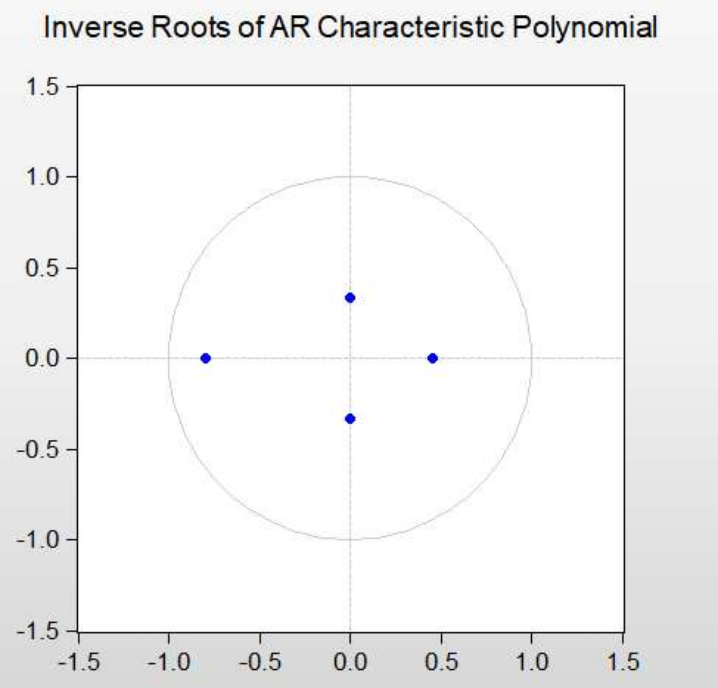

Figure 2. Unit circle test

Based on the above test analysis, the final regression equation obtained is:

$$LNY = 2.148 + 0.169\ LNX1 - 0.682LNX3 - 0.146LNX4 + e1$$
(3.4599) (4.7986) (-6.9089) (-2.9763)
(0.025) (0.008) (0.3437) (0.0049)
R2 = 0.9827, F = 32.609

5. Conclusion of the Study and Recommendations for Countermeasures

5.1. Findings

The coefficient of the digital financial inclusion index is 0.169, and the significance level is 5%. The results of the study show that the development of regional digital financial inclusion is positively correlated with the non-performing loan ratio of Ningbo banks, and the H0 hypothesis is valid. In order to improve its competitiveness in the financial market, Bank of Ningbo will increase its credit investment, thus reducing the demand for loans to enterprises and individuals and lowering the threshold for loan applications, which will increase the probability of the bank's non-performing assets. The coefficient of capital adequacy ratio is -0.682 which is significantly higher than 5%. This implies that if a bank has a higher capital ratio,

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then it will have a lower bad debt ratio. The provision coverage ratio is -0.146 at 5% significant level of significance. This also means that the bank has more capital to bear the losses while making provision for bad debts and thus reduces the credit risk.

Although the regression coefficients of both cost-income ratio and GDP growth rate are not very significant, these two variables have some reference significance. The significance of the first test lies in the fact that during the period from 2011 to 2022, Bank of Ningbo reduces the non-performing rate by controlling the operating costs, expanding the types of credits, and developing the intermediary business.The GDP growth rate test lies in the fact that when it is in the period of stable economic development, Bank of Ningbo increases the applications for loans, and is able to pay back the principal and interest of the loans very well, the economy is developing well, so the increase in the amount of the loans can better promote the development of the local economy and the non-performing rate will decrease.

5.2. Recommendations for Countermeasures

(1) Utilize big data technology to improve credit risk management and control and accelerate digital transformation

In the information age, computer technology is used to take more specific measures to actively respond to the challenges brought about by the development of financial technology. The level of credit risk management can be improved by applying Internet technology, and a perfect risk control system can be constructed by utilizing big data technology. Multi-dimensional collection of customers' multi-dimensional information data, multi-level and multi-directional credit risk assessment for customers, to achieve more detailed and accurate credit risk management, to minimize the risk of non-performing loans generated by urban commercial banks. The development of digital inclusive finance can promote Bank of Ningbo's innovation in business sustainability and improve risk control ability. At the same time, it introduces composite talents proficient in Internet technology, builds a more specialized risk control team, and effectively controls the credit risk of urban commercial banks.

(2) Developing low-risk, high-growth retail business to drive bank profit growth

Bank of Ningbo completed the structural adjustment of its retail business, with consumer loans accounting for a relatively high proportion of the retail business and lower personal mortgage loans. In terms of the industry environment, the operating environment of city commercial banks has changed a lot. Public credit is facing the requirement of pressing down interest rate, which makes the net interest margin narrow, and city commercial banks need to find new growth breakthroughs. For city commercial banks, the higher the proportion of retail business, the more stable the net interest margin income and the higher the asset quality. The key to tapping into profit growth lies in further improving risk control capabilities and digging into the incremental space of retail business as much as possible under the premise of effectively controlling the non-performing rate. City commercial banks are realizing the transformation of retail business in the context of the rapid development of digital inclusive finance, driving consumer demand and promoting economic recovery and growth.

(3) The State should further strengthen the regulation of digital finance in order to promote the healthy and orderly development of the banking industry.

In recent years, non-banking fintech companies have grown, developed and expanded in a short period of time, and people are ignorant of the financial risks and unfair competition behind the digital financial market. Relevant state departments should improve the regulatory framework in a timely manner to guide the healthy development of digital finance, so as to avoid its development leading to problems of unfair competition in the financial market and disrupting the healthy and orderly development of the banking industry. Based on the common characteristics of different digital financial companies and technologies, a common digital financial regulatory standard should be established, and a financial regulatory system with

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differentiation should be set up for different characteristics. Regulators must fully recognize the rapid and widespread popularization of the Internet, improve the adaptability of financial regulation, and continuously innovate financial regulatory tools to strengthen the regulation of digital finance.

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