

The Impact of Digital Finance Development on Inclusive Credit of Local Small and Medium-sized Banks: An Empirical Study Based on Provincial Panel Data in China

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Abstract. As a crucial financial support for regional economies and small and micro enterprises, local small and medium-sized banks face numerous challenges in their inclusive credit operations. Although the emergence of digital finance has brought pressure for change to banks, it has also created new opportunities for banks of all sizes to address these challenges. To systematically explore the impact mechanism and actual effectiveness of digital finance development on micro-bank inclusive credit business, this paper utilizes panel data from various provinces in China and analyzes it using a fixed-effects model. Empirical findings show that the widespread use of online loans has greatly promoted the expansion of inclusive credit scale by local banks of various sizes, while maximizing the effective level of credit resource allocation. This, to some extent, intensifies competitive pressure among banks. This finding provides empirical evidence for understanding the collaborative development of digital finance and traditional financial institutions, and has important reference significance for optimizing regional financial policies and driving the digital transformation of micro-banks.

Keywords: Digital Finance, Local Small and Medium-sized Banks, Inclusive Credit, Panel Analysis, Credit Structure.

1. Introduction

With the rapid development of the Internet plus economy (Liu, 2025) ^[4], it has had a significant impact on regional economic structures and their mobility. Its development primarily relies on technological advancements, the growing demand from consumers and small and micro enterprises, as well as national policy support (Zhang & Zhang, 2025) ^[8]. To serve the real economy and achieve social equity, inclusive finance is a key approach (Cai, 2025) ^[1]. In this wave of transformation, some entities play a particularly crucial role, such as local small and medium-sized banks that directly serve the regional real economy and long-tail consumers, while also facing unique challenges. However, the rapid development of digital finance brings new opportunities to address these challenges (Huang & Hong, 2024) ^[3]. By utilizing digital technology, especially financial innovations centered on big data risk control, information asymmetry issues have been significantly alleviated. This measure reshapes the credit intermediary function of banks, enabling them to provide sustainable credit services to long-tail customers (Cai & Luo, 2024) ^[2]. The application of digital technology can mitigate information asymmetry (Zhang, 2025) ^[7], reduce credit risk through precise customer profiling, and expand the scope of credit boundaries (Wang & Bai, 2025) ^[6]. The rapid development of digital finance may intensify competition in the banking industry (Ma, 2025) ^[5], leading to changes in customer behavior patterns and putting pressure on its traditional business. Existing research often focuses on the impact of digital finance on macro-financial stability, government debt, and consumer spending (Zhang, 2025) ^[9], often neglecting its direct effects and underlying mechanisms on key factors at the micro level (Zhu, 2025) ^[10]. A comprehensive exploration of this issue can not only clarify how digital finance affects regional financial development but also greatly assist in optimizing business strategies and improving the inclusive finance system. To explore the impact of digital finance development, this study intends to conduct an empirical analysis from the perspective of multiple banks using provincial panel data. It hopes to provide theoretical support and practical

references for the formulation of inclusive credit policies in the new era and the transformation and development of banks

2. Research Design

This study explores the relationship between inclusive credit scale and core explanatory variables such as the Digital Finance Development Index, as well as control and mechanism variables including individual bank characteristics, regional economy, and digital transformation. The data comes from the CSMAR database and internal bank data, covering panel data from 2015 to 2018 for 31 provinces in China (excluding some provinces with missing data). Table 1 shows the variable definition.

Table 1. Variable design

Variable type	Variable name	Variable symbol	Variable definition and measurement
Explained variable	Inclusive credit scale	Credit	Inclusive micro and small enterprise loan balance / Total loan balance $\times$ 100%
Core explanatory variable	Overall Digital Finance Development Index	Digital_index	Peking University Digital Inclusive Finance Index (Provincial Level)
	Coverage breadth	Coverage	Digital financial service account coverage, payment account coverage, etc
	Using depth	Usage	For use in various services
	Degree of digitalization	Digitization	The levels of mobileization, intelligence, and creditization
Control variables (at the regional level)	GDP per capita	GDP_pc	Gross regional domestic product / year-end permanent resident population (logarithmic)
	Urbanization rate	Urban	Urban permanent resident population / Total population $\times$ 100%
Mediating variable	Easing of financing constraints	Fin_Constraint	Interest expense / Operating revenue $\times$ 100%
	Technological innovation and improvement	Tech_Innovation	R&D investment / operating income $\times$ 100%
	Expansion of household consumption	Consumption	Growth rate of total retail sales of consumer goods
Instrumental variable	Lagged one-period digital finance index	L.Digital_index	T-1 period digital inclusive finance index
	Digital finance development in neighboring regions	Neighbor_digital	Weighted average of digital finance index of neighboring provinces

Based on this study, this paper will utilize three regression models. Model 1 primarily reflects the comprehensive effect of the overall digital finance development index, Model 2 delves deeper from three sub-dimensions, while Model 3 introduces mediating variables to explore its mechanism of action.

$$Credit = \alpha + \beta_1 Digital_index + \gamma Controls + \varepsilon \quad (1)$$

$$Credit = \alpha + \beta_1 Coverage + \beta_2 Usage + \beta_3 Digitization + \gamma Controls + \varepsilon \quad (2)$$

$$Credit = \alpha + \beta_1 Digital_index + \delta Mediators + \gamma Controls + \varepsilon \quad (3)$$

Variable description: α is a constant term, β_1 , β_2 , β_3 are core explanatory variables, δ is a mediator variable, γ is the regression coefficient of control variables, and ε is the overall disturbance term.

3. Empirical Analysis

Table 2. Descriptive statistics of main variables

Variable name	Number of observations	Mean	Standard deviation	Minimum	Maximum
Total Index	124	255	40.54	186.38	377.73
Coverage breadth	124	231	44.18	139.87	353.87
Using depth	124	242	61.78	125.25	400.40
Degree of digitalization	124	358	39.19	293.12	453.66
Per capita GDP(10,000 yuan)	124	6	2.67	2.60	14.00
Urbanization rate	124	0.6	0.12	0.30	0.88

According to Table 2, digital inclusive finance has seen a steady increase in coverage depth and breadth from 2015 to 2018. However, with market saturation or statistical adjustments, the breadth of coverage may show a downward trend.

According to Table 3, there is a positive correlation between the scale of inclusive credit and these three factors. This indicates that as the inclusive credit provided by small and medium-sized banks increases, the overall development level of digital inclusive finance improves.

Table 3. Correlation coefficient matrix of main variables, inclusive credit, and core variables (2015-2018)

Variable	Inclusive credit	Total Index	Coverage breadth	Using depth	Degree of digitalization
Inclusive credit	1.0000				
Total Index	0.8562***	1.0000			
Coverage breadth	0.8214***	0.9811***	1.0000		
Using depth	0.7345***	0.9266***	0.8775***	1.0000	
Degree of digitalization	0.2145*	0.0233	-0.0258	-0.2646**	1.0000

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4 shows that digital inclusive finance is on the rise. With the continuous deepening of digital financial services in various business scenarios, the table also reflects the most significant growth in usage depth, and the overall coverage breadth is on an upward trend.

Table 4. Annual Trend of Digital Inclusive Finance Index (2015-2018)

Year	Total Index	Coverage breadth	Using depth	Degree of digitalization
2015	220.0	180.0	150.0	320.0
2016	260.0	200.0	250.0	360.0
2017	280.0	220.0	280.0	340.0
2018	290.0	210.0	300.0	380.0

Note: The data represents the annual average for each province

According to the benchmark regression results in Table 5, coverage breadth has a significant positive relationship with inclusive credit, and its promoting effect is much stronger than that of usage depth. The inhibitory effect was the strongest in 2017, reflecting the cyclical impact of the external environment on inclusive credit.

Table 5. Benchmark regression results

Variable	Fixed effect	Fixed effect - time	Random effect
Coverage breadth	0.769***	0.538***	0.670***
	(0.031)	(0.081)	(0.024)
	[0.707,0.832]	[0.377,0.699]	[0.624,0.717]
Using depth	0.112***	0.524***	0.187***
	(0.022)	(0.034)	(0.017)
	[0.069,0.155]	[0.457,0.592]	[0.154,0.221]
Constant term	50.106***	26.161	54.827***
	(3.497)	(16.207)	(2.777)
	[43.160,57.052]	[-6.047,58.370]	[49.384,60.269]"
Number of observations	124	124	124"
Number of groups	31	31	31"
Overall R ²	0.9783	0.9754	0.9814"
F-statistic	2178.36 ($p=0.0000$)	3571.41" ($p=0.0000$)"	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

According to Table 6, the Hausman test results indicate that the random effect model is not suitable for this experiment, and the fixed effect model is better, providing significant implications for subsequent analysis and experiments.

Table 6. Hausman test results

Variable	FE coefficient	RE coefficient	Difference	Standard error
Coverage breadth	0.769***	0.670***	0.099	0.031
Using depth	0.112***	0.187***	-0.075	0.022
Hausman $\chi^2(2) = 54.30$				
P-value < 0.0001				

4. In-Depth Analysis

Table 7 indicates significant regional and economic environmental differences in promotion. The eastern region outperforms the western region, with a decreasing trend from east to west, and high GDP areas are more sensitive than low GDP areas.

Table 7. Heterogeneity analysis: grouping by region and economic development level

Grouping	Coverage breadth coefficient	Use depth coefficient	Number of observations
Eastern region	0.852***	0.135***	44
	(0.038)	(0.028)	
Central China	0.712***	0.098***	40
	(0.045)	(0.032)	
Western region	0.635***	0.085**	40
	(0.052)	(0.035)	
Small and medium-sized banks in the high GDP group	0.801***	0.125***	62
	(0.041)	(0.030)	
Small and medium-sized banks in the low GDP group	0.689***	0.092***	62
	(0.043)	(0.033)	

Note: The standard error is indicated in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8 shows that alleviating financing constraints, promoting technological innovation, and expanding consumer spending all exhibit significant partial mediating effects.

Table 8. Mechanism test: mediation effect analysis

Mechanism variable	Mediating effect	Sobel test	Conclusion
Financing constraints	0.152***	Z=3.45	Partially mediated through
	(0.045)	(p=0.001)	
Technological innovation	0.098**	Z=2.12	Partially mediated through
	(0.042)	(p=0.034)	
Household consumption	0.121**	Z=2.67	Partially mediated through
	(0.047)	(p=0.008)	

Note: The standard error is indicated in parentheses; *** $p < 0.01$, ** $p < 0.05$

According to Table 9, digital finance has a significant positive spatial correlation effect on inclusive credit.

Table 9. Spatial effect analysis: results of spatial Durbin model

Variable	Coefficient estimation	Direct effect	Indirect effect	Total effect
Coverage breadth	0.603***	0.658***	0.166***	0.824***
	(0.085)	(0.033)	(0.042)	(0.045)
Using depth	0.132***	0.145***	0.035***	0.180***
	(0.042)	(0.025)	(0.018)	(0.031)
Spatial lag term	0.315***			
	(0.088)			

Note: The standard error is indicated in parentheses;*** $p < 0.01$

5. Conclusion

To promote the development of inclusive banking by local banks, the advancement of digital finance has played a crucial role. The higher heterogeneity analysis coefficient in the eastern region has a positive impact on both transformation and inclusive banking. This study proposes from the following aspects: incorporating digital inclusive finance at the national level will greatly assist credit; different regulatory approaches should be formulated for regions with uneven development; and there should be significant breakthroughs for banks in terms of technical talent cultivation and risk control capability enhancement.

Despite systematically examining the mechanisms in related aspects, this study still has several limitations: Firstly, due to the availability of micro-data, this study mainly relies on aggregated data at the provincial level and fails to delve into the micro-mechanisms at the individual bank and customer levels. Secondly, although endogenous issues have been addressed through instrumental variables and various robustness checks, the description of the impact mechanisms remains relatively simplified. Future research can delve into two directions: one is to strive to obtain panel data at the bank level and start from specific perspectives; the other is to adopt case studies and field research methods to compensate for the deficiencies of large-sample quantitative analysis, conduct in-depth analysis of typical practices, and provide new ideas and support for their future improvement.

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