



The Dark Side of Digital Financial Inclusion: Evidence on Risk-Taking Behavior in Chinese Commercial Banks

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Abstract

The rapid development of digital inclusive finance has brought profound transformations to the financial industry, particularly affecting commercial banks, which are its core institutions. The increasing accessibility and efficiency of digital financial services have significantly pressured traditional banking activities, particularly in deposit mobilization and lending. This disruption has led to a decline in net interest margins, thereby weakening bank profitability. In response, commercial banks may be incentivized to pursue higher-risk investment strategies to preserve their franchise value, thereby increasing their overall risk-taking. Accordingly, this study aims to examine the impact of digital inclusive finance on the risk-taking levels of Chinese commercial banks. This research adopts a quantitative approach, using panel data from Chinese commercial banks over a specified period. The analysis employs regression models to examine the relationship between the development of digital inclusive finance and bank risk-taking, while controlling for relevant variables, including bank size, liquidity, and operational efficiency. The findings indicate that digital inclusive finance has a significant positive effect on commercial banks' risk-taking behavior. The compression of profit margins compels banks to seek alternative sources of income through higher-risk investment instruments. Furthermore, the effect is more pronounced among banks with lower levels of digital adaptation. The implications of this study highlight the necessity for well-structured digital transformation strategies and strengthened financial regulation. Commercial banks are encouraged to pursue sustainable innovation while adhering to prudential principles, and regulators are urged to design adaptive policies to ensure financial stability and an effective risk prevention and control system.

Keywords: *Commercial Banks, Digital Inclusive Finance, Financial Regulation, Risk Appetite, Risk-taking*

A. Introduction

The rapid expansion of digital inclusive finance (DIF) has fundamentally reshaped the global financial landscape, particularly in emerging economies such as China. Driven by regulatory relaxation and continuous financial innovation, traditional banking models are increasingly being replaced by digitally enabled financial ecosystems. By leveraging advanced technologies such as big data, artificial intelligence, and cloud computing, DIF significantly reduces transaction costs, lowers entry barriers, and broadens access to financial services for previously underserved populations. This transformation has not only enhanced financial efficiency but also promoted greater equity and inclusiveness within the financial system (Demirgüç-Kunt et al., 2018; Ozili, 2018). In China, the government has actively promoted DIF

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as a national strategy, including the pilot implementation of a central bank digital currency since 2020, signaling a strong institutional commitment to digital financial transformation (Huang & Wang, 2020). However, this rapid evolution also introduces new and unexpected challenges for traditional financial institutions.

Despite the widely acknowledged benefits of DIF, its disruptive impact on commercial banks has generated a paradoxical phenomenon. On the one hand, DIF improves operational efficiency and expands service outreach; on the other hand, it intensifies competition, particularly with the entry of fintech firms and large technology companies. These developments have eroded traditional sources of bank revenue, particularly in deposit-taking and lending, leading to declining net interest margins and increased pressure on profitability (Vives, 2019; Philippon, 2016). More critically, this financial disintermediation may push banks toward higher-risk investment strategies to maintain their competitive position and franchise value. Such a shift raises concerns about increased systemic vulnerability, making the relationship between DIF and bank risk-taking both complex and empirically intriguing.

Although a growing body of literature has examined financial inclusion and fintech development, limited attention has been paid to how DIF specifically influences commercial banks' risk-taking behavior. Existing studies tend to focus either on the positive effects of financial inclusion on economic growth or on the efficiency gains from fintech adoption, often overlooking the potential risks to traditional banking institutions (Beck et al., 2016; Frost et al., 2019). Moreover, empirical evidence on this issue remains fragmented, particularly in China, where DIF has developed rapidly under unique institutional and regulatory conditions. This gap highlights the need for a more nuanced and systematic investigation that integrates perspectives from financial innovation, banking behavior, and risk management.

To address these limitations, this study proposes a comprehensive empirical analysis of the impact of DIF on the risk-taking behavior of Chinese commercial banks using panel data methods. By focusing on the risk-taking channel, this research offers a novel perspective that goes beyond traditional efficiency and inclusion narratives. The importance of this study lies in its potential to inform both academic discourse and policy practice. For banks, understanding the risk implications of DIF is essential for designing balanced digital transformation strategies that align innovation with prudential management. For regulators, the findings provide critical insights for developing adaptive and forward-looking regulatory frameworks to safeguard financial stability in the digital era. Ultimately, this study contributes to building a more resilient and inclusive financial system by bridging the gap between technological advancement and risk governance.

B. Literature Review

Digital inclusive finance and commercial banks are highly correlated. However, there is no consensus on the impact of digital inclusive finance on commercial banks' risk-taking. Some scholars believe that the development of digital financial inclusion has exacerbated the various risks faced by banks. From the perspective of financial supervision, although technology enhances financial efficiency by reducing information asymmetry and transaction costs, it also introduces new regulatory challenges, such as regulatory arbitrage and the emergence of shadow banking, requiring regulators to adapt innovatively (Buchak et al., 2018). Moreover, the improper promotion of digital financial inclusion not only fails to improve financial stability but also significantly increases banks' and the entire financial system's risk exposure, particularly in economies with poor institutional quality (Ozturk & Ullah, 2022). From the perspective of bank management, although the development of digital inclusive finance has a positive impact on the

profitability, security, and growth of commercial banks, it negatively affects liquidity, thereby increasing liquidity risk (Dong et al., 2020).

Other studies believe that the development of digital inclusive finance has two sides to the impact of bank risk-taking. From a technical perspective, digital technology not only reduces banks' loan risks stemming from information asymmetry but also enhances risk mitigation and maximizes the accuracy of risk assessment when combined with financial inclusion (Yang & Masron, 2024). At the same time, the vigorous development of digital inclusive finance has also created huge market opportunities and development space for fintech companies. Currently, banks have realized that collaboration with fintech companies is both a key way to promote innovation and inevitably brings related challenges (Drasch et al., 2018). One view believes that fintech companies do not simply replace traditional banks, but enhance the inclusiveness of basic financial services of traditional banks through the technologies such as mobile money they create (Aracil et al., 2025), providing new ideas for systematically solving their dilemmas in credit risk and operational risk. Another view suggests that it can enhance bank performance by optimizing lending rates and liability structures, while methods to reduce risk-taking for performance improvement remain underexplored (Liu et al., 2024). Recent studies have begun to systematically examine this issue using Chinese banking data (Chen, Liu, and Zhang, 2025), yet the underlying mechanism—particularly the role of net interest margin—remains underexplored. This paper aims to fill this gap.

C. Methods

This study employs a quantitative research design to examine the impact of digital inclusive finance (DIF) on the risk-taking behavior of Chinese commercial banks. A panel data approach captures both cross-sectional and time-series variation, enabling a more robust analysis of dynamic relationships (Baltagi, 2021). The dependent variable in this study is bank risk-taking, commonly proxied by indicators such as non-performing loan (NPL) ratios and risk-weighted assets, which are widely used in banking risk literature (Laeven & Levine, 2009). The key independent variable is the level of digital inclusive finance development, measured using established DIF indices developed in prior studies (Guo et al., 2020). In addition, several control variables are incorporated, including bank size, liquidity, capital adequacy, and operational efficiency, to reduce omitted-variable bias and improve the reliability of the estimates (Beck et al., 2013).

The research procedure begins with the identification and selection of a representative sample of Chinese commercial banks over a specified observation period. The study follows a structured empirical research framework, starting from variable construction based on prior empirical studies to ensure conceptual validity (Wooldridge, 2010). Subsequently, relevant financial and operational data are compiled into a balanced panel dataset. Data preprocessing techniques, including handling missing values and winsorizing extreme outliers, are applied to enhance data quality and prevent estimation bias (Gujarati & Porter, 2009). The model specification phase includes developing baseline regression models and conducting robustness checks to ensure the stability and consistency of the empirical results.

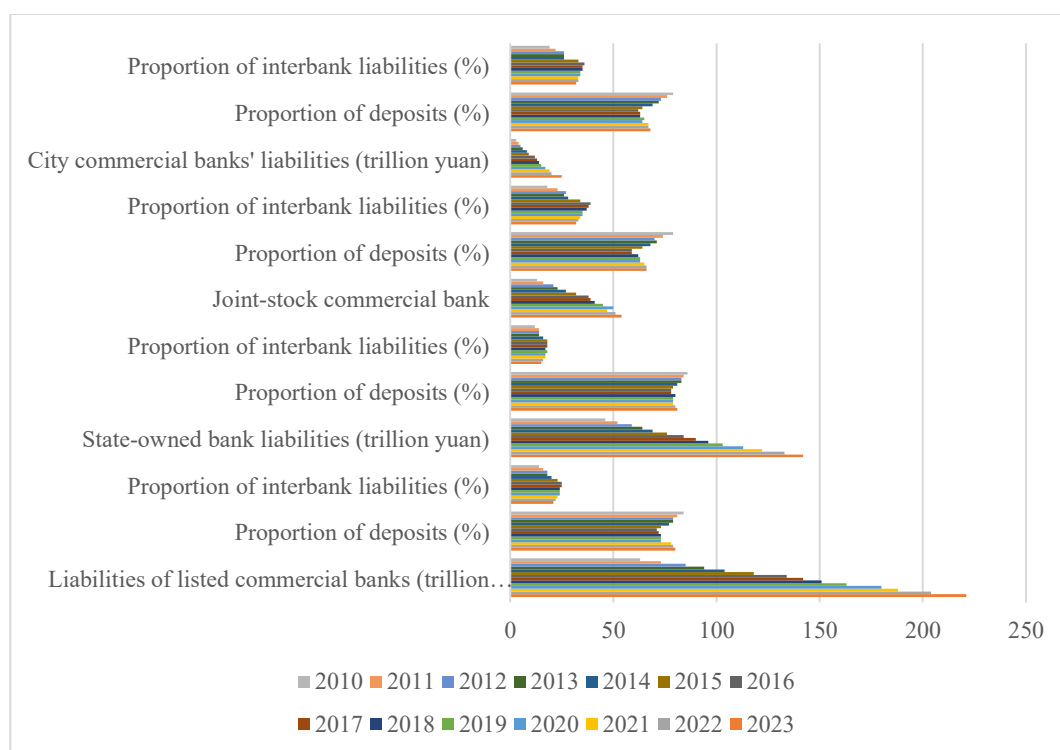
Data for this study are collected from secondary sources, primarily consisting of publicly available financial statements, annual reports of Chinese commercial banks, and financial databases such as CSMAR and WIND, which are widely used in financial research (Chen et al., 2021). Data on digital inclusive finance are obtained from authoritative sources, particularly the Peking University Digital Financial Inclusion Index of China, which has been extensively validated in prior studies (Guo et al., 2020). The use of secondary panel data enhances objectivity

and allows for broader temporal and cross-sectional coverage. To ensure data reliability, triangulation is conducted by cross-verifying data from multiple sources, a method commonly recommended in empirical financial research (Yin, 2018).

The data analysis technique employs panel regression models, including fixed- and random-effects estimations, to examine the relationship between DIF and bank risk-taking. The Hausman test is conducted to determine the most appropriate model specification (Hausman, 1978). Additionally, robustness tests are conducted using alternative proxy variables and lagged independent variables to address potential endogeneity issues (Arellano & Bond, 1991). All statistical analyses are conducted using econometric software, and the results are interpreted based on statistical significance, coefficient direction, and economic relevance. This approach ensures that the findings are both methodologically sound and theoretically meaningful in explaining the impact of digital inclusive finance on banking risk behavior.

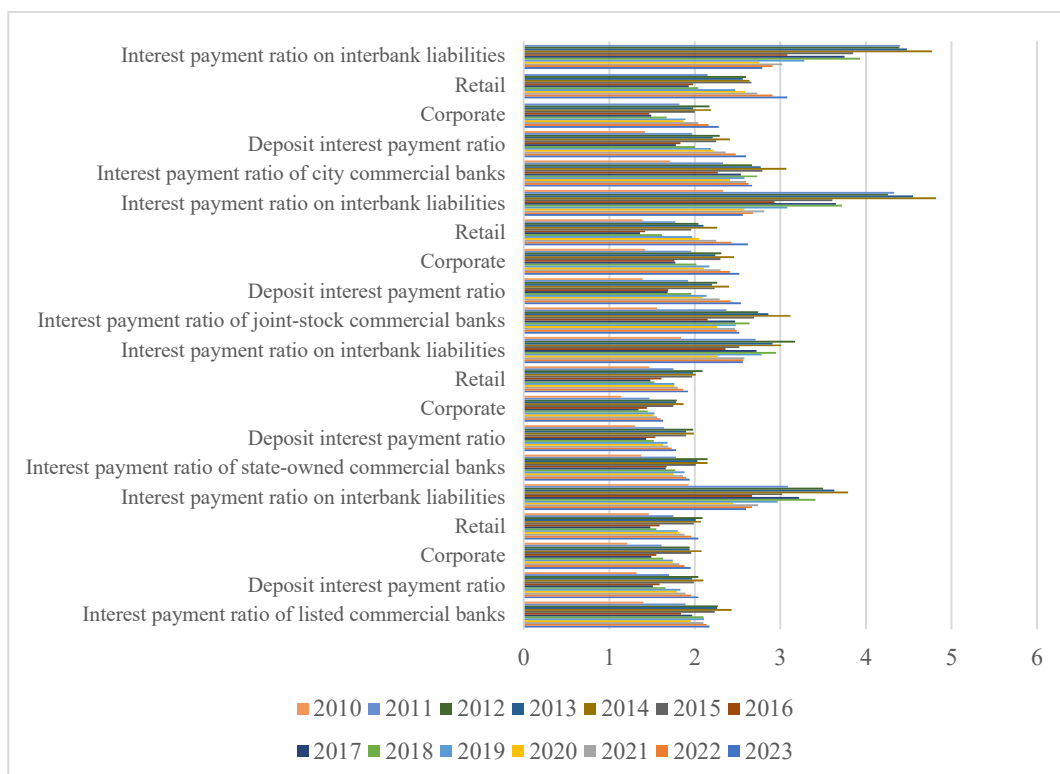
D. Results and Discussion

The development of digital inclusive finance has introduced new challenges for commercial banks in liability management. According to a China Banking Association analysis of 35 A share listed banks from 2010 to 2023 (as shown in Figure 1 and Figure 2)—representing 80% of total industry liabilities—two clear trends have emerged: the average proportion of demand deposits declined from 58% to 42%, while interbank liabilities rose from 18% to 35%. During the same period, the average liability cost ratio increased by 1.2 percentage points, reflecting a broad upward trend in funding costs driven by these structural shifts.



Data Source: China Banking Association

Figure 1. Debt structure of listed banks from 2010 to 2023

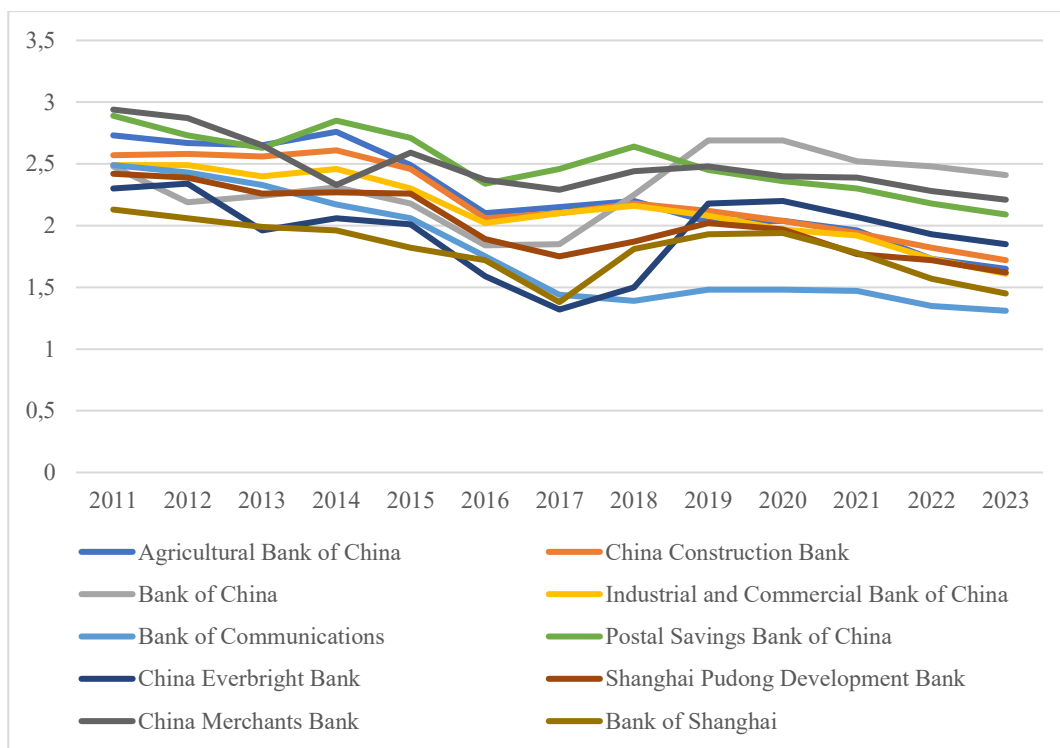


Data Source: China Banking Association

Figure 2. Cost of liabilities of listed banks from 2010 to 2023

Rising liability costs have compressed banks' loan interest margins, pressuring profitability. In response, many banks have raised medium- and long-term deposit rates to attract funds. However, digital inclusive finance has shifted public wealth management preferences toward short- to medium-term financial products—such as internet-based funds like Yu'e'bao—which offer low thresholds and high flexibility, especially among younger generations. This has made it harder for banks to attract long-term deposits. As Wang (2023) highlights, the shift in retail depositor behavior toward digital wealth management products has fundamentally altered the maturity structure of bank liabilities, further pressuring banks' net interest margins and incentivizing risk-taking. To seek higher returns, banks have expanded lending into the long-tail market. Yet without mature digital risk-control systems, they face severe information asymmetry and greater risks, while internet finance companies hold a clear advantage in fintech. These shifts highlight the banking industry's challenges in adapting to digital inclusive finance and the need to develop new profit models and risk management strategies. Hypothesis 1: Driven by the pursuit of profits, digital inclusive finance will prompt commercial banks to increase risk-taking.

In the early stages of digital inclusive finance, commercial banks largely overlooked the long tail market, resulting in minimal overlap with internet finance companies in traditional asset management. As shown in Figure 3, from 2011 to 2023, the net interest margins of ten major listed banks generally declined. By 2023, margins had fallen significantly across most banks, with particularly notable decreases at Bank of China, China Postal Savings Bank, and Shanghai Pudong Development Bank.



Data Source: China Banking Association

Figure 3. Trend of net interest margin of 10 listed banks from 2011 to 2023 (unit%)

As narrowing net interest margins push banks to expand into the long-tail loan market, their still-incomplete digital transformation leaves them at a disadvantage compared to internet finance companies, which leverage mature digital tools and credit systems to reduce information asymmetry and better assess risk. Consequently, banks assume riskier assets while facing competitive pressure to lower loan rates and ease credit requirements, and digital inclusive finance may even exacerbate this risk-shifting behavior (Chen et al., 2021). This dynamic, coupled with the shift toward more expensive wholesale funding, further squeezes margins and increases banks' risk exposure. Thus, while seeking growth in the long-tail market, commercial banks face heightened credit risk and compressed profitability amid the rise of digital inclusive finance. Hypothesis 2: Digital inclusive finance increases the risk-taking level of commercial banks through the "digital inclusive finance - net interest margin - risk-taking" path.

Digital inclusive finance platforms pressure commercial banks on both assets and liabilities, compressing interest spreads and net interest margins, which undermines profitability. To preserve their franchise value, banks may turn to higher-risk investments, further increasing their risk-taking. This paper constructs the following baseline model:

$$Z_{it} = \alpha_0 + \alpha_1 LIF_{it} + \alpha_2 Con_{1it} + \varepsilon_{1it} \quad (1)$$

$$NIM_{it} = \beta_0 + \beta_1 LIF_{it} + \beta_2 Con_{2it} + \varepsilon_{2it} \quad (2)$$

$$Z_{it} = \delta_0 + \delta_1 LIF_{it} + \delta_2 NIM_{it} + \delta_3 Con_{3it} + \varepsilon_{3it} \quad (3)$$

In the above equations, *i* represents individual banks, *t* represents time; *Z* is the target dependent variable, representing the risk level of commercial banks, *LIF* is the main independent variable, representing the digital inclusive finance evaluation index; *NIM* is the mediating variable, representing the net interest margin of commercial banks, and *Con* represents control factors; ε represents the residual.

This paper selects the Z-score as a proxy variable for the risk-taking level of commercial banks. A higher Z-score indicates greater stability and lower risk for the bank. The Z-score is calculated as Ln (return on assets (ROA) plus capital adequacy ratio (CAR) divided by the standard deviation of return on assets (σ ROA)). In addition to the Z-score, we select the non-performing loan ratio (NPL) as an alternative indicator to comprehensively measure bank risk.

This paper uses the Digital Inclusive Finance Index published by Peking University from 2011 to 2023 as the base data, reflecting three main aspects: coverage breadth, usage depth, and digitalization level. This paper uses net interest margin (NIM) as a mediating variable to explore the mechanism by which digital inclusive finance affects commercial banks' risk-taking. The net interest margin is a key measure of bank profitability. It represents the ratio of a bank's net interest income to its average interest-earning assets, reflecting the core earnings from lending and the efficiency with which it manages interest-related costs.

Based on previous research on bank risk-taking and its determinants (Altunbas et al., 2018; Jiang et al., 2020; Laeven & Levine, 2022; Basten & Juelsrud, 2023), this paper includes the following control variables in the model. This paper selects the GDP growth rate of each province as a measure to eliminate the interference of the national economy; the growth rate of the broad money supply (M2) is used to measure the monetary supply situation, reflecting the amount of broad money circulating in the entire economic system; the asset size of commercial banks (LNA) is often used as a representative of their business scale, with larger scales potentially leading to a wider range of business types and scope, and possibly higher risk-taking levels; the liquidity situation of commercial banks (BL) reflects their loan-to-deposit ratio, with lower liquidity indicating a potentially higher risk preference; the profitability level of commercial banks (BP) is closely related to their risk-taking, with declining profits potentially leading to greater risk tolerance and higher-risk behaviors to enhance profitability. The above control variables will help eliminate the impact of non-systematic factors on risk levels. This paper selects relevant data from 101 commercial banks in China for the period 2011 to 2023 as the research sample. The data mainly come from the Wind database, the Bankscope database, the CSMAR database, the "China Statistical Yearbook," and the "Peking University Digital Inclusive Finance Index (2011-2023)."

Consistent with recent empirical studies on digital finance and bank risk-taking (Li & Xu, 2022), this study employs the SYS-GMM method to address endogeneity and weak-instrument concerns, thereby enhancing the robustness of the estimates. This study employs the SYS-GMM method to address endogeneity and weak-instrument concerns, thereby enhancing the robustness of the estimates. The empirical results in Table 1 show: column (1) reports the overall negative impact of digital inclusive finance on commercial banks' risk-taking capacity; column (2) indicates that it reduces banks' net interest margin, a key profitability measure, thereby influencing their risk preference; and column (3), after removing mediation effects, provides a more precise estimate of its direct impact on bank risk levels.

Table 1. Mechanism Identification of Digital Inclusive Finance Impact on Bank Risk-Taking: Baseline Test Results

Verification Order	Step 1	Step 2	Step 3
Variable	Z	NIM	Z
	(1)	(2)	(3)
LIF	-0.4830***	-0.0063***	-0.4670***
	(3.0412)	(0.0171)	(0.6301)
NIM			0.0122**

			(0.0193)
GDP	-3.8240***	-0.0361***	0.3969*
	(0.0496)	(0.7062)	(0.0508)
M2	0.5403***	0.8168***	0.5539***
	(0.0453)	(0.1309)	(0.0483)
LNA	0.5960**	-2.1971***	0.0579***
	(0.0237)	(-0.2983)	(0.0284)
BL	-0.0172*	-0.0233	-0.0017**
	(0.0075)	(0.0319)	(0.0076)
BP	-0.0077***	1.0442***	-0.0788***
	(0.7700)	(0.3271)	(0.1378)

Note: The numbers in parentheses are the cluster-robust standard errors of each variable. *, **, *** represent significance levels of 1%, 5%, and 10%, respectively (the same below). The P-values are in the brackets on the right side of the test.

According to the data analysis in Column (1) of Table 1, when the significance level is set at 1%, the coefficient of the digital inclusive finance index (LIF) is negative, indicating a positive relationship between the expansion of digital inclusive finance and the risk-taking of commercial banks. Specifically, the development of digital inclusive finance raises the risk-taking levels of commercial banks. The rapid growth of non-bank financial intermediaries is competing with traditional banks for market share, eroding banks' risk resilience. Additionally, by expanding services to broader, often marginal, customer segments, digital inclusive finance heightens competition in deposits and loans, squeezing bank profitability. To sustain profits, commercial banks are incentivized to pursue higher-risk investments, further increasing their overall risk exposure. Therefore, this paper validates Hypothesis 1 proposed in Chapter 1, that the development of digital inclusive finance drives commercial banks to increase risk-taking in pursuit of profits.

According to the results in Column (2) of Table 1, the coefficient of the main explanatory variable, the digital inclusive finance index (LIF), is negative and significant at the 1% level, revealing the negative impact of the continuous progress of digital inclusive finance on the net interest margin (NIM) of commercial banks; that is, as digital inclusive finance spreads, the net interest margin level of commercial banks will decline. In addition, compared with the results of the first step of the analysis, the coefficient for the digital inclusive finance index shows a decreasing trend, indicating that the decline in the net interest margin of commercial banks further exacerbates bank risk-taking. This validates Hypothesis 2 in this paper: digital inclusive finance increases commercial banks' risk-taking by reducing their net interest margins.

Based on the data in Column (3) of Table 1, the coefficient of the mediating variable, the net interest margin (NIM) of commercial banks, is positive and meets the 1% significance level requirement; the digital inclusive finance index remains significant and is smaller than the coefficient in the first step, again confirming the validity of Hypothesis 2, that digital inclusive finance increases the risk-taking of commercial banks by reducing banks' net interest margin (NIM), while also indicating that the net interest margin (NIM) plays a certain mediating role.

This study examines how digital inclusive finance impacts commercial banks' net interest margin (NIM) through three core dimensions: coverage breadth (LIFB), usage depth (LIFD),

and digitalization level (LIFDD). According to the regression results in Table 2, compared with the original model in Table 1, the regression coefficients of the core variable coverage breadth index (LIFB) and the use depth index (LIFD) are still negative and the significance has not changed, which shows that the three key dimensions of digital inclusive finance: breadth, depth, and digitalization have all intensified the competitive pressure of commercial banks on digital inclusive finance platforms at both ends of assets and liabilities to a certain extent. With the continuous development and penetration of digital inclusive finance, the traditional asset and liability management methods of commercial banks are facing challenges, which has led to the continuous reduction of net interest margins, which in turn has a negative impact on the profitability of banks and increased risk taking, confirming the view that the development of digital inclusive finance has exacerbated the risk-taking of commercial banks.

Table 2. Heterogeneity Test Results

Variable	NIM	NIM	NIM
lnLIFB	-2.3940***		
	(0.9400)		
lnLIFD		-2.4210***	
		(0.6253)	
lnLIFDD			-3.9430***
			(0.3640)
GDP	-0.7811***	-0.6510***	-0.5195***
	(0.1962)	(0.1960)	(0.1736)
M2	0.7220***	0.5585***	0.9701***
	(0.1295)	(0.0378)	(0.1695)
LNA	-6.1820***	-0.1250***	-0.2490***
	(0.7726)	(0.8190)	(1.1124)
BL	0.0480	0.0550	0.0840
	(0.4500)	(0.0240)	(0.1630)
BP	0.0680***	0.0720***	0.1090***
	(0.4600)	(0.0450)	(0.6550)

In addressing the endogeneity issue of variables, this paper uses the System Generalized Method of Moments (System GMM) method, combining the level equation and the difference GMM strategy to improve the accuracy and precision of the estimation results. This method effectively addresses the endogeneity bias that may arise from the interaction between variables.

In this paper, to verify the robustness of the previous empirical analysis results, the strategy of using the non-performing loan ratio (NPL) of commercial banks as the core alternative variable is adopted to further explore the robustness of its impact on the digital inclusive finance index. The non-performing loan ratio (NPL) is an important indicator of bank risk level, where a higher NPL indicates a higher risk of loan default faced by the bank, reflecting that the bank's

risk-taking level is actually increasing. If robustness is confirmed, NPL and LIF should show a negative correlation, while showing a positive correlation with the net interest margin.

According to the test results in Table 3, for the analysis of the explanatory variable digital inclusive finance index (LIF), it is observed that the coefficient in Column (3) is reduced compared to the coefficient in Column (1), indicating that under different model settings, the estimated impact of digital inclusive finance on banking business is consistent but the strength varies. At the same time, the non-performing loan ratio (NPL) of commercial banks shows a negative correlation with the net interest margin (NIM) of banks as intermediaries. This means that as the non-performing loan ratio increases, the net interest margin of banks decreases, reflecting that increased risk may compress the interest margin income of banks. This finding supports the view of Hypothesis 2.

Table 3. Robustness Analysis Results

Test Order	Step 1 NPL	Step 2 NIM	Step 3 NPL
LIF	-0.4830***	0.0321***	-0.5760***
	(3.0474)	(0.3730)	(3.0070)
NIM			0.0112**
			(1.9321)
GDP	-3.8240***	-0.4470	-3.9690***
	(-4.9672)	(-0.4615)	(-5.0843)
M2	-5.4030***	-2.1970	-5.5390***
	(-4.5365)	(-1.3042)	(-4.8376)
LNA	0.5960**	-0.1680*	0.5790**
	(-2.3715)	(-0.8349)	(-2.476)
BL	-0.0737	0.0312	-0.0768
	(-0.7537)	(-0.3180)	(-0.7697)
BP	-0.0770	0.0440	-0.0780
	(-0.7746)	(-0.3225)	(-0.7800)

E. Conclusion

The research results show that the development of digital inclusive finance drives commercial banks to increase risk-taking in pursuit of profits. Digital inclusive finance squeezes the deposit and loan businesses of commercial banks, leading to a decline in net interest margins and making banks more inclined to engage in high-risk investments, thereby increasing their risk-taking, forming the "digital inclusive finance - net interest margin - risk-taking" path. Based on the above conclusions, the following policy recommendations are proposed: (1) Commercial banks need to improve their risk management frameworks, enhance risk management levels, fully utilize the spillover effects of digital inclusive finance, combine internal risk management, establish more comprehensive risk identification mechanisms, and improve banks' risk response capabilities; (2) Accelerate the digital transformation of banking businesses, improve the innovation capabilities of banking businesses, take proactive actions, accelerate comprehensive digital transformation, and enhance innovation capabilities. Continuously innovate products and

services, introduce talents with expertise in both IT and finance, increase investment in financial innovation, and accelerate risk management transformation.

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