Research on the Impact of FinTech on Commercial Banks' Green Credit

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Abstract: This paper selects data from 21 commercial banks spanning 2014 to 2023, constructs a FinTech index as the core explanatory variable, and uses the proportion of green credit in total bank loans as the dependent variable to conduct an empirical study with a two-way fixed effects model. A heterogeneity analysis is also performed based on bank ownership. The findings are as follows: First, FinTech promotes the development of green credit in commercial banks. Second, FinTech in state-owned banks has a significantly positive effect on green credit, which may be attributed to the fact that joint-stock banks lag behind state-owned banks in the scale of FinTech application. Based on these results, this paper proposes suggestions to address existing issues in the application of FinTech in green credit: regulatory authorities should take the lead in establishing unified standards, and focus on cultivating relevant professional talents.

Keywords: FinTech; Green Credit; Commercial Banks; Profitability

1. Introduction

With the intensification of global climate change, promoting the development of green finance has become a high consensus and core strategic orientation among governments and financial institutions worldwide. Green credit, a key pillar of FinTech development, aims to inject capital into green industries and projects aligned with sustainable development, such as environmental protection, energy conservation, and clean energy, through the leverage of financial tools. It serves as a critical link between the implementation of macro policies and the green practices of micro-economic entities, helping environmental protection enterprises overcome technological challenges, expanding the scale of clean energy projects, and driving the entire economic ecosystem toward environmental friendliness. However, the advancement of traditional green credit business faces numerous difficulties. For commercial banks, exploring the impact of FinTech on green credit helps enhance operational competitiveness, improve service quality, optimize business processes, increase green credit efficiency, and strengthen risk management capabilities to reduce non-performing loan ratios. For the green financial market, such research promotes healthy and high-quality development and market standardization. For society, green credit drives sustainable economic development while enhancing public environmental awareness.

Guo (2024) conducted an empirical study on commercial banks, finding that FinTech application significantly promotes green credit business in banks with higher capital adequacy ratios. FinTech's role in boosting green credit is more pronounced by enhancing information identification accuracy and optimizing credit allocation efficiency [1]. Scholars such as Huang et al. (2023) argue that commercial banks should accelerate FinTech innovation to drive the vigorous development of green finance in China. Using text analysis to construct a FinTech development index, their research shows that FinTech promotes green credit issuance by reducing credit risks, improving information distribution, and alleviating information asymmetry [2]. Zhong et al. (2023) identified that factors driving the growth of green credit scale include FinTech development level, regional data infrastructure, and banks' talent accumulation. FinTech effectively accelerates the operation of commercial banks' green credit business through accurate identification of credit recipients [3]. Wei (2023) explored the application potential of FinTech in green finance against the backdrop of FinTech empowering green finance development, aiming to optimize and strengthen its practical application in this field, ensuring FinTech fully exerts its effectiveness to inject vitality into green finance [4]. Tian (2023) believes that FinTech, through big data and other means, enables green credit to provide efficient and accurate credit management services. He conducted an in-depth discussion from the perspective of integrating FinTech into green credit and proposed targeted optimization strategies [5]. Wang et al. (2024) used text mining to construct a FinTech development evaluation index and applied a two-way fixed effects model to analyze how FinTech regulates commercial banks' risk levels in green credit business. The results showed that FinTech effectively strengthens the role of green credit in reducing commercial banks' risks [6].

Liu and You (2023) found that FinTech affects green credit through two key mechanisms: information asymmetry and green credit allocation efficiency. Financial institutions should utilize FinTech for pre-loan investigations of green credit, and policymakers should encourage FinTech development, improve information disclosure policies, and establish environmental information sharing platforms [7]. Daniela Gabor et al. (2017) regarded digital-based inclusive finance as an indicator for the development of national institutions and FinTech companies, exploring the digital revolution in inclusive finance and illustrating the international development status in the era of global FinTech [8]. Liem Nguyen Thanh et al. (2022) recorded three key findings: first, the growth of FinTech credit competes with banks but also enhances bank stability; second, credit information sharing improves bank stability; third, credit information sharing is one of the factors influencing the impact of FinTech credit on bank stability [9]. Song et al. (2019) used the generalized method of moments (GMM) and found that the proportion of Equator Principles project financing in international banks positively affects their operational capabilities, while the green credit ratio of Chinese commercial banks is negatively correlated with their profitability, indicating that China and other regions worldwide are in significantly different stages [10].

2. Theoretical Analysis

2.1 Alleviating Information Asymmetry

Commercial banks can use big data technology to collect massive, multi-dimensional customer data, including transaction records, credit history, and social media behavior. By analyzing and mining these data, banks can gain a more comprehensive understanding of customers' financial status, consumption habits, and credit risks, thereby reducing information asymmetry. For example, data on various behaviors and transactions on platforms like Alipay helps better assess users' credit status and repayment capacity. By acquiring such real-time and accurate data, banks can precisely grasp enterprises' operational conditions, avoid false information reporting, and reduce information asymmetry risks.

2.2 Enhancing Risk Management Capabilities

Intelligent approval systems based on big data and artificial intelligence can quickly process loan applications, automatically screen qualified customers, and provide approval opinions. This improves the efficiency of credit approval, reduces errors in manual approval, and enables banks to better identify high-quality customers. Using artificial intelligence and machine learning algorithms to analyze collected customer data, banks can more accurately assess credit risks and default probabilities. Intelligent risk control models can automatically identify risk signals and issue early warnings, making credit decisions and risk control more scientific and accurate. FinTech also facilitates intelligent and real-time post-loan management. Through real-time monitoring of customer accounts, repayment reminders, and risk alerts, banks can promptly detect abnormalities and take corresponding measures to reduce moral hazards and default losses.

2.3 Stimulating Commercial Banks' Initiative

FinTech enhances commercial banks' enthusiasm for green credit from multiple dimensions. With big data and intelligent algorithms, banks can accurately assess green project risks and effectively reduce potential default risks. By deeply mining enterprises' environmental data, banks can clearly understand their environmental sustainability capabilities. The application of automated approval processes and smart contracts greatly simplifies credit procedures, reduces labor costs, and improves operational efficiency. FinTech also helps banks identify potential customers in emerging green industries. For instance, in the booming new energy vehicle industry chain, banks can layout in advance to provide credit support. Additionally, FinTech assists banks in meeting regulatory requirements by monitoring capital flows in real time to ensure funds are used for designated purposes. This not only enhances banks' reputation but also attracts more environmentally conscious investors and customers, forming a virtuous cycle that comprehensively drives banks to engage actively in green credit business.

3. Research Design

3.1 Sample Selection

This paper selects data from 21 domestic commercial banks from 2014 to 2023, including 6 state-owned banks (Bank of China, Agricultural Bank of China, Industrial and Commercial Bank of China, China Construction Bank, Bank of Communications, and Postal Savings Bank of China), 9 joint-stock banks (China Everbright Bank, Ping An Bank, Huaxia Bank, Minsheng Bank, CITIC Bank, Shanghai Pudong Development Bank, Industrial Bank, China Merchants Bank, and Zheshang Bank), and 6 city commercial banks (Bank of Beijing, Bank of Jiangsu, Bank of Ningbo, Bank of Shanghai, Bank of Changsha, and Bank of Hangzhou). These 6 city commercial banks were selected because their average assets exceeded 2 trillion yuan in 2023. Empirical data are sourced from the China Stock Market & Accounting Research (CSMAR) database, annual reports of banks, and Baidu News. Data related to green credit are obtained from the Social Responsibility Reports of sample banks. Stata software is used for empirical analysis.

3.2 Variable Selection and Definitions

(1) Dependent Variable

This paper selects the green credit ratio (a relative indicator) as the dependent variable, which is the core focus of the study. A higher value indicates greater support for green industries in banks' lending business, reflecting the level of participation and business development in green finance, and is significant for promoting sustainable economic development.

Table 1. FinTech Keyword Lexicon

Dimension	Keywords
Artificial Intelligence	Robotics, machine learning, deep learning, artificial intelligence, neural networks, biometrics, image recognition, voiceprint recognition, pattern recognition, facial recognition payment, facial recognition, augmented reality, virtual reality, knowledge graph, intelligentization, smart deposits, smart counters, smart finance, smart branches, smart credit, smart type, smart marketing, smart banks, intelligence, intelligent finance, intelligent risk control, automation, natural language processing.
Blockchain	Blockchain, distributed ledger, supply chain, Internet of Things, near field, quantum, quantum communication, data encryption, digital currency, electronic currency.
Cloud Computing	Distributed, distributed database, distributed architecture, distributed computing, distributed storage, financial cloud, trusted computing, cloud migration, private cloud, virtualization, privacy computing, cloud, cloud services, cloud service platform, cloudification, cloud computing, cloud architecture, cloud platform, cloud system, cloud disaster recovery.
Big Data	Big data, big data analysis, big data services, big data technology, big data models, big data mining, data warehouse, data model, data technology, data center, data governance, data mining, digitalization, digital transformation, digital signature, digital ecology, digital credit card, digital finance, digital bank, digital marketing.
Online Services	E-commerce, electronization, electronic finance, electronic channels, e-banking, electronic payment, Internet, Internet finance, FinTech, digital technology, networking, online finance, online wealth management, online financing, online consumer loans, online banking, online payment, web-based, online transactions, online banking services, online payment, Internet banking, online, online presence.
Mobile Services	Scenario-based, scenario finance, application programming interface (API), open platform, open banking, platformization, software development kit (SDK), mobile banking, mobile payment, barcode payment, mobile e-commerce, mobile internet, mobile finance, mobile banking services, mobile payment, digital payment, API, direct banking.

(2) Explanatory Variable

The FinTech index is used as the core explanatory variable. Current measures of FinTech are generally divided into two categories: one is the Digital Financial Inclusion Index of China compiled by the Digital Finance Research Center of Peking University; the other is the FinTech development index constructed using text mining by Guo and Shen (2019) [11]. Drawing on the method of Zhai et al. (2023) [12], this paper constructs a FinTech development index for commercial banks' data from 2014 to 2023. Using machine learning, it extracts word frequency data of 124 relevant keywords across 6 dimensions (artificial intelligence, blockchain, cloud computing, big data, online services, and mobile services) (see Table 1), and performs logarithmic processing on the results for benchmark regression analysis.

(3) Control Variables

Considering banks' risk-bearing capacity, liquidity, and operational efficiency, the following 5 control variables are selected:

Loan-to-Deposit Ratio (LDR): Reflects the efficiency of fund allocation and liquidity of financial institutions. A excessively high LDR may indicate overuse of funds and increased liquidity risks, potentially limiting the ability to issue green credit; a low LDR may imply underutilization of funds, affecting profitability and indirectly impacting green credit business.

Non-Performing Loan Ratio (NPL): Reflects the quality of financial institutions' credit assets. A high NPL ratio indicates greater credit risks, making banks more cautious in lending, including green loans, thus negatively affecting the green credit ratio.

Capital Adequacy Ratio (CAR): A higher CAR means banks have more capital buffers to absorb economic losses. Basel III stipulates that commercial banks' common equity tier 1 capital adequacy ratio must be at least 4.5%, and total capital adequacy ratio must not be less than 8% [13].

Return on Equity (ROE): Reflects financial institutions' ability to generate profits using net assets. A higher ROE indicates stronger profitability, potentially providing more resources and motivation to expand green credit business.

Bank Size (LnSIZE): Measured by the natural logarithm of total assets, reflecting scale advantages. Larger banks have significant advantages in green credit, leveraging their strengths to support green industries and reduce risks [14].

Table 2 shows the names, symbols, and calculation methods of each variable. The specific meaning is shown in the table below:

Table 2. Variable Descriptions

Variable Type	Variable Name	Symbol	Calculation Method
Dependent Variable	Green Credit Ratio	GCR	Green loan amount/Total loans
Explanatory Variable	FinTech Index	FIN	Constructed via text mining
Control Variables	Loan-to-Deposit Ratio	LDR	Loans/Deposits
	Non-Performing Loan Ratio	NPL	Non-performing loans/Total loans
	Capital Adequacy Ratio	CAR	Capital adequacy ratio
	Return on Equity	ROE	Net profit/Average shareholders' equity
	Bank Size	LnSIZE	Natural logarithm of total assets

3.3 Model Specification

This paper uses panel data for regression analysis and constructs a two-way fixed effects model to explore the mechanism of FinTech's impact on commercial banks' green credit:

$$GCR_{it} = C + a_1 FIN_{it} + a_2 LDR_{it} + a_3 NPL_{it} + a_4 CAR_{it} + a_5 ROE_{it} + a_6 LnSIZE_{it} + \lambda_i + \gamma_t + \varepsilon_{it} \quad (1)$$

In this model, the green credit ratio (GCR) is the dependent variable, reflecting the development of commercial banks' green credit. The explanatory variable FIN represents the potential impact of FinTech on green credit; a positive coefficient indicates a promoting effect. Five control variables are included: LDR, ROE, NPL, CAR, and LnSIZE. λ_i denotes bank-specific fixed effects，γ_t denotes year fixed effects，and ε_it is the random error term.

4. Empirical Results Analysis

4.1 Descriptive Statistics

Table 3 presents descriptive statistics of 21 commercial banks from 2014 to 2023. The mean green credit ratio is 0.061, indicating a relatively low proportion of green loans in total loans, with significant room for development. The minimum value is 0, and the maximum is 0.294, showing a wide range of green credit ratios, reflecting uneven participation in green credit among banks. The mean NPL ratio is 0.014 with a standard deviation of 0.003, indicating stable asset quality without significant risks. The average bank size is 10.773, with a minimum of 7.681 and a maximum of 12.889, suggesting selected banks have certain scale and variability.

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
GCR	210	0.061	0.053	0	0.294
FIN	210	5.097	0.819	1.609	6.783
LDR	210	0.808	0.158	0.323	1.162
NPL	210	0.014	0.003	0.006	0.024
ROE	210	0.128	0.032	0.06	0.215
CAR	210	0.136	0.018	0.096	0.193

4.2 Correlation Analysis

According to the relevant analysis results in Table 4, it can be seen that the correlation coefficient between the FinTech index and green credit is 0.229, showing a significant positive correlation. It also has significant positive correlations with LDR, CAR, and bank size, indicating that green credit issuance is affected by multiple factors. The strongest correlation is between CAR and bank size, suggesting larger banks have more abundant capital reserves. Overall, correlation coefficients between variables are below 0.7, indicating moderate correlations.

Table 4. Correlation Analysis

	GCR	FIN	LDR
GCR	1.000		
FIN	0.229***	1.000	
LDR	0.161**	0.375***	1.000
NPL	0.093	0.046	0.458***
ROE	-0.132*	-0.455***	-0.592***
CAR	0.323***	0.209***	0.151**
LnSIZE	0.380***	0.090	0.232***

	NPL	ROE	CAR	LnSIZE
NPL	1.000			
ROE	-0.267***	1.000		
CAR	-0.037	-0.266***	1.000	
LnSIZE	0.277***	-0.223***	0.605***	1.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3 Multicollinearity Test

To enhance the accuracy and reliability of regression results, variance inflation factor (VIF) analysis is used to detect multicollinearity. As shown in Table 5, the maximum VIF value is 1.88, below the empirical threshold of 10.

Table 5. Multicollinearity Test

Variable	VIF	1/VIF
LDR	1.88	0.5306
ROE	1.73	0.5790
NPL	1.35	0.7406
FIN	1.32	0.7562
LnSIZE	1.11	0.8977
Mean VIF	1.48	

4.4 Benchmark Regression Results

To ensure robustness, results with and without control variables are presented. Columns (1) in Table 6 show results without control variables, and Columns (2) with control variables.

Table 6. Benchmark Regression

	(1)	(2)
	GCR	GCR
FIN	0.021***	0.009**
	(0.003)	(0.004)
LDR		-0.099**
		(0.039)
ROE		-0.355*
		(0.182)
CAR		-0.320
		(0.288)
LnSIZE		0.051***
		(0.014)
_cons	-0.046***	-0.340**
	(0.016)	(0.171)
N	210.000	210.000
r2	0.201	0.318
year	YES	YES
id	YES	YES

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; t-values are in parentheses.

In-depth analysis shows that without control variables, the coefficient of FinTech on green credit is 0.21, significant at the 1% level, indicating a significant positive correlation. This confirms that FinTech advancement strongly drives green credit development. After introducing control variables, the coefficient becomes 0.009, significant at the 5% level, further verifying FinTech's positive effect. Bank size has a coefficient of 0.051, significant at the 1% level, indicating larger banks have stronger financial capacity to support green credit.

4.5 Heterogeneity Analysis

Commercial banks differ in FinTech development and green credit policy implementation due to ownership differences. This study divides banks into state-owned banks, joint-stock banks, and city commercial banks. Table 7 shows varying impacts: FinTech has the most significant effect on state-owned banks.

First, Column (1) in Table 7 shows the correlation coefficient between the FinTech index and green credit in state-owned banks is 1.66, significant at the 1% level, indicating FinTech significantly promotes their green credit business. Second, Columns (2) and (3) show insignificant results for joint-stock and city commercial banks, possibly due to their smaller scale and reduced lending during the pandemic. However, their positive coefficients indicate a certain positive correlation.

Table 7. Heterogeneity Analysis

	(1)	(2)	(3)
	GCR	GCR	GCR
FIN	1.660***	0.508	0.579

	(0.607)	(0.867)	(0.839)
LDR	-0.092	-0.126**	-0.079
	(0.132)	(0.057)	(0.060)
NPL	-1.554	0.392	-12.092***
	(2.326)	(1.589)	(2.665)
ROE	0.631	-0.487*	-1.111***
	(0.409)	(0.259)	(0.346)
CAR	1.319*	-1.258**	-0.741
	(0.686)	(0.477)	(0.456)
LnSIZE	7.388	7.225***	0.136
	(6.072)	(2.619)	(2.013)
_cons	-108.488	-41.140	44.679*
	(68.852)	(29.669)	(25.529)
N	60.000	90.000	60.000
r2	0.577	0.287	0.577
year	YES	YES	YES
id	YES	YES	YES

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; t-values are in parentheses.

4.6 Robustness Test

The core explanatory variable is replaced with the logarithmic form of Peking University's Digital Financial Inclusion Index (LnFIN), and its sub-indicators: coverage breadth (LnFIbr) and coverage depth (LnFIde). Empirical results in Table 8 show that FinTech remains significantly positive for green credit after replacement, confirming a consistent positive correlation regardless of the explanatory variable used.

Table 8. Robustness Test

	(1)	(2)	(3)	(4)
	GCR	GCR	GCR	GCR
FIN	0.009**			
	(0.004)			
LDR	-0.099**	-0.138***	-0.146***	-0.142***
	(0.039)	(0.040)	(0.042)	(0.039)
NPL	-1.635	-0.648	-0.366	0.099
	(1.211)	(1.208)	(1.246)	(1.205)
ROE	-0.355*	-0.114	-0.198	-0.042
	(0.182)	(0.193)	(0.189)	(0.188)
CAR	-0.320	-0.586**	-0.493*	-0.605**
	(0.288)	(0.294)	(0.291)	(0.283)
LnFIN		0.127***		
		(0.035)		
LnFIbr			0.130***	
			(0.040)	
LnFIde				0.097***
				(0.020)
_cons	-0.340**	-0.512***	-0.479***	-0.420**
	(0.171)	(0.169)	(0.170)	(0.162)
N	210.000	210.000	210.000	210.000
r2	0.318	0.350	0.340	0.380
year	YES	YES	YES	YES
i	YES	YES	YES	YES

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; t-values are in parentheses.

5. Research Conclusions and Policy Recommendations

This paper analyzes the relationship between FinTech and green credit from both theoretical and empirical perspectives. Theoretical analysis suggests that FinTech alleviates information asymmetry, improves banks' risk management capabilities, and stimulates their initiative in green credit. Using data from 21 domestic commercial banks, with the green credit ratio as the dependent variable and a text-mined FinTech index as the core explanatory variable, the empirical study via a two-way fixed effects model confirms that FinTech significantly promotes green credit development, which is robust to tests. Heterogeneity analysis shows that larger banks benefit more from FinTech in driving green credit.

Policy recommendations include: strengthening FinTech application, increasing R&D investment, promoting industry-university-research cooperation to accelerate innovation in green credit; unifying industry standards, standardizing the green finance system, and building information sharing platforms to reduce information asymmetry.

Acknowledgments

This paper is supported by the Mathematics and Finance Research Center of Dazhou City (No. SCMF202511).

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