

The Impact of Green Credit on the Profitability of Commercial Banks: An Empirical Study based on the Chinese Banking Industry

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Abstract

Within the framework of the 'Carbon peak and carbon neutrality goals' objective, the role of green credit as a crucial green finance instrument is progressively emerging as a principal path for the evolution and progress of commercial banking institutions. Nonetheless, the real effect of green credit on bank profitability and the success of policy measures remains a matter of debate. The study develops both a fixed-effects regression model and a double-difference model (DID), utilizing panel data from China's A-share listed banks between 2007-2023, to empirically investigate how the green credit ratio influences the profitability (ROA) of commercial banks, and to delve deeper into the moderating impact of green finance policies and the diversity of bank types. Investigations reveal that green credit adversely affects the overall profitability of the sample, hinting at potential hurdles for green initiatives like extended profit cycles and elevated short-term risks; in the case of joint-stock banks, the post-policy interaction term is notably positive, implying that while the green financial policy enhances the profitability of these banks to some degree, its impact remains somewhat restricted. The results offer a detailed empirical foundation for assessing green credit efficiency and refining policies.

Keywords

Green Credit; Bank Profitability; Policy; Bank Heterogeneity; Panel Data Model.

1. Introduction

As climate change and environmental pollution issues continue to escalate, global attention on green sustainable development has been steadily increasing. As a major contributor to global carbon emissions, China, a significant source of worldwide carbon emissions, has been vigorously advocating for the creation of an eco-friendly financial framework lately to fulfill its strategic objectives of 'carbon peaking and carbon neutrality.' Green credit, integral to green finance, signifies a bank's capacity to aid in the green transformation of the actual economy and acts as a crucial metric for assessing a bank's commitment to social responsibility and its success in sustainable development.

Existing research has extensively explored the policy role, development models, and contributions of green credit to economic growth or carbon emissions reduction[1]. Some scholars point out that green credit can reduce default risk and enhance the bank's brand image, thereby strengthening the bank's profitability[2]. However, some studies have found that green credit may increase project screening and risk control costs in the early stages, leading to a decline in short-term profitability. In addition, most literature still focuses on the macro perspective, and empirical analyses of how green credit affects banks' micro-level profitability

remain limited, especially lacking a systematic examination of the regulatory mechanisms of green finance policies and their heterogeneous effects on banks.

Stemming from this, the study endeavors to scrutinize how green credit affects the financial success of commercial banks on a smaller scale, utilizing panel data from Chinese A-share listed banks spanning 2007 to 2023. It further analyses whether the strength of policy support moderates this relationship and whether there are significant differences between different types of banks. Compared with existing research, the innovations of this paper primarily include: introducing the difference-in-differences method into the empirical model to identify policy effects, thereby enhancing the causal explanatory power of the identification; using bank type as an entry point to explore the heterogeneous differences in green credit performance, providing a basis for the formulation of differentiated policies.

This study holds significant theoretical and practical implications. On the one hand, it enriches micro-empirical research on green finance performance evaluation, providing empirical support for how green credit affects bank profitability. On the other hand, the findings can serve as a scientific reference for financial regulatory authorities to optimize green credit policy tools and promote bank green transformation.

2. Literature Review

Green credit, as an important component of green finance, refers to financial institutions such as banks providing financing support to guide capital flows toward energy-saving, emission-reduction, and environmentally friendly projects[3]. Driven by China's 'dual carbon' strategic goals, the scale of green credit has expanded rapidly, regulatory policies have gradually improved, and a green credit policy tool system has been preliminarily established[4]. Green credit not only reflects a bank's ability to fulfil its social responsibilities, but also has a profound impact on credit structure, risk management and profit models.

Current research lacks agreement regarding the link between green credit and the profitability of banks. One view holds that green credit helps improve bank profitability. On the one hand, green projects usually have government backing and policy support, making them relatively low risk. On the other hand, a green image can also enhance a bank's brand effect and attract ESG-conscious customers[5].

Another type of research points out that green credit may have a negative impact on bank profits in the short term. The reasons include: green projects have long cycles and slow capital recovery; project identification and risk assessment costs are high; and regulatory disclosure requirements increase operating costs[6]. Wang Xiaoguang et al think that green credit adversely affects commercial banks' financial outcomes, with smaller and medium-sized banks experiencing more severe negative impacts compared to their larger counterparts[7]. Zhang Yu's study revealed that green credit doesn't notably influence local commercial banks' operations, yet it diminishes the financial success of state-owned and joint-stock commercial banks[8]. Wang Jianqiong and Dong Ke observed that green credit operations don't notably affect the earnings of small and medium joint-stock commercial banks, and they even lower the profits of large state-owned banks[9]. The role of green credit policies as an external measure is garnering more focus for their influence on green credit efficiency. Governmental initiatives in green finance, including support for green bonds, interest subsidies, and re-lending strategies, play a dual role in lowering green credit costs for banks and motivating them to enhance their eco-friendly financing initiatives[10]. On the other hand, policy uncertainty and differences in implementation may also interfere with its effectiveness. Bose found that green credit performance was more significant in regions with high policy intensity, indicating that policy support intensity may be an important moderating variable for green finance performance[11].

To sum up, current studies have investigated how green credit influences banking efficiency in various aspects, including its potential effects on profitability, risk control, and social image, and has also preliminarily identified the importance of policy support and bank type differences. However, current research still has the following shortcomings: first, existing empirical studies mostly focus on the analysis of static relationships and lack dynamic identification of differences in impact before and after policy implementation; second, most studies treat green finance policies as a unified background variable and rarely identify key policy nodes as quasi-natural experiments.

To fill the aforementioned research gap, this paper uses 2016, the year when China's green finance policy was launched, as a natural breakpoint and constructs a difference-in-differences (DID) model to assess the impact of green credit on bank profitability before and after the implementation of the policy. The study concentrates on examining the varied reactions of diverse banking institutions, including state-owned and joint-stock banks, to policy disruptions.

3. Research Methods

The objective of this study is to investigate how the growth of green credit enterprises affects bank profitability and to determine if the enactment of policies intensifies or lessens this correlation. As a shift in the allocation of financial resources, green credit may increase bank operating costs and reduce the space for traditional high-yield loans in the short term, thereby affecting their profitability. Therefore, it is necessary to empirically test whether an increase in the proportion of green credit has a negative impact on banks' return on assets (ROA). Additionally, considering that China officially issued the 'Guiding Opinions on Building a Green Financial System' in 2016, this paper further employs the difference-in-differences method to identify the moderating effect of policy factors on this relationship.

The comprehensive research structure unfolds thusly: initially, a panel fixed-effects model is developed to evaluate the green credit ratio's effect on bank profitability; next, the difference-in-differences approach is implemented to discern policy impacts; and ultimately, comprehensive robustness assessments and diversity analyses are performed to bolster the conclusions' dependability.

3.1. Data Sources and Sample Description

The study focuses on commercial banks listed on the Chinese A-share market from 2007 to 2023. Data sources include the CSMAR database and publicly available information such as bank annual reports. To ensure the representativeness of the sample and data integrity, banks with missing key variables or insufficient annual observations were excluded, resulting in a final dataset of 36 banks' balanced panel data. Bank types are classified according to regulatory categories into state-owned banks, joint-stock banks, city commercial banks, etc. Green credit data were approximated using the ratio of green loan balances to total loans. Auxiliary data include non-performing loan ratios, capital adequacy ratios, revenue growth rates, and asset sizes. The empirical analysis tool used in this study is Stata 18.

3.2. Variable Setting

This paper selects bank profitability as the dependent variable, represented by return on assets (ROA). The core explanatory variable is the green credit ratio (*Greencredit_Ratio*), which measures the weight of green credit business in a bank's total loans. In the robustness test, the logarithm of green credit balance (*Ln_green*) is also introduced as an alternative variable. In terms of control variables, the analysis includes multiple indicators reflecting bank operations and financial condition, such as non-performing loan ratio (NPL), capital adequacy ratio (CAR), provision coverage ratio (PCC), cost-to-income ratio (CIR), and bank size (*Ln_Asset*).

3.3. Model Setting

3.3.1. Benchmark Model Specification: Panel Fixed Effects Model

To analyse the impact of green credit on bank profitability, this paper constructs the following fixed-effects model.

$$ROA_{it} = \alpha + \beta_1 Greencredit_Ratio_{it} + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

In this model, i represents the bank, t represents the year, γX_{it} represents the control variable group, μ_i represents the bank fixed effect, λ_t represents the time fixed effect, and ε_{it} represents the error term. The model is estimated using robust standard errors based on bank-level clustering.

3.3.2. Difference-in-Differences Model (DID)

To further identify the effects of green finance policies in 2016, this paper introduces the DID model. Banks with higher green credit ratios are set as the treatment group, and time dummy variables and interaction terms are introduced:

$$ROA_{it} = \alpha + \beta_1 Greencredit_Ratio_{it} + \beta_2 treated_i + \beta_3 post2016_t + \beta_4 (treated_i \times post2016_t) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Among these, $treated$ is a dummy variable for the treatment group, $post2016$ is a dummy variable for the post-policy year, and the interaction term is used to identify the marginal effect of the policy shock.

4. Empirical Analysis

4.1. Descriptive Statistical Analysis

Table 1. Descriptive statistical analysis results

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	596	0.99736	0.28002	0.14850	2.13490
Greencredit_Ratio	379	0.06454	0.14342	0.00058	2.07017
Ln_green	379	5.999513	2.140958	-0.11653	10.89674
NPL	580	1.42964	1.33563	0.16000	23.57000
CAR	585	13.18852	2.69442	0.11000	40.30310
PCC	579	260.20090	115.45210	33.01000	830.70000
CIR	596	32.14136	6.76726	17.69720	72.68080
Ln_Asset	596	9.12458	1.88823	5.35748	13.01025

As shown in Table 1, the descriptive statistics summarize the key variables used in this study. The dependent variable is return on assets (ROA), which measures a bank's profitability. The mean value for the sample period is 0.997, the standard deviation is 0.280, the minimum value is 0.1485, and the maximum value is 2.1349. This indicates that the overall profitability of the sample banks is above average, but there are still significant differences between individual banks.

The core explanatory variable, the green credit ratio, is a key indicator for measuring the intensity of a bank's green credit resource allocation. Its mean is 6.45%, standard deviation is 14.35%, maximum value reaches 20.71%, and minimum value is only 0.0577%, indicating significant differences among banks in terms of green finance development levels. To conduct

a robustness test, this paper also introduces the natural logarithm variable of green credit balance (Ln_green), with a mean of 6 and a maximum value of 10.90

In terms of control variables, the non-performing loan ratio (NPL) has a mean of 1.43%, but a maximum value as high as 23.57%, indicating that some banks have higher credit risk exposure; the average capital adequacy ratio (CAR) is 13.19%, with a wide range of fluctuations, indicating structural differences among banks in their capital supplementation capabilities; the average provision coverage ratio (PCC) is 260.20%, with a standard deviation of 115.45% and a maximum value as high as 830.70%, further indicating significant differences among banks in their risk mitigation capabilities.

The average cost-to-income ratio (CIR) was 32.14, reflecting overall stable operational efficiency among the sample banks, though with some fluctuations. The logarithmic mean of asset size was 9.12, with a minimum of 5.36 and a maximum of 13.01, indicating that the sample encompassed banks of varying sizes from medium to large.

4.2. Variable Correlation Analysis

Table 2. Variable correlation matrix

	ROA	Greencredit_Ratio	NPL	CAR	PCC	CIR	Ln_Asset
ROA	1.0000	-0.0735	-0.3424	-0.0378	0.1892	-0.1490	0.1782
Greencredit_Ratio		1.0000	0.1432	0.2512	-0.0605	-0.0602	0.1073
NPL			1.0000	0.1598	-0.7048	-0.2597	0.1421
CAR				1.0000	0.0388	-0.1997	0.1916
PCC					1.0000	0.2127	-0.2873
CIR						1.0000	-0.0547
Ln_Asset							1.0000

To gain an initial understanding of the linear relationships among the various variables, this paper conducted a Pearson correlation analysis on ROA, the green credit ratio, and the control variables, with the results shown in Table 2.

As shown in the Table 2, the correlation coefficient between the green credit ratio and bank profitability (ROA) is -0.0735. Although the direction is negative, the correlation is weak, suggesting that there may be a non-linear or moderated relationship between the two, potentially influenced by other factors. The correlation between the non-performing loan ratio (NPL) and ROA is significant (-0.3424), consistent with theoretical expectations, indicating that deteriorating loan quality can suppress profitability levels. Among other control variables, the provision coverage ratio (PCC) is positively correlated with ROA (0.1892), indicating that more robust risk mitigation mechanisms can enhance bank profitability; the correlation coefficient between bank size and ROA is 0.1782, suggesting that larger banks have a certain advantage in terms of profitability.

Overall, the correlation coefficients between most variables did not exceed 0.5, indicating no significant multicollinearity risk. However, further validation through VIF tests is required in subsequent model validation.

4.3. Benchmark Regression Analysis

To examine whether the expansion of green credit business affects bank profitability, this paper uses return on assets (ROA) as the dependent variable and employs a fixed-effects model for benchmark regression analysis. The core explanatory variable in the model is the green credit ratio, with control variables including non-performing loan ratio (NPL), capital adequacy ratio (CAR), provision coverage ratio (PCC), cost-to-income ratio (CIR), and the logarithm of bank asset size. To control for unobservable individual heterogeneity among banks and enhance the

robustness of standard errors, the regression employs robust standard errors based on bank-level clustering.

Table 3. Benchmark regression results

Variable	Coefficient	Std. Err.	t-value	p-value	95% Confidence Inte
Greencredit_Ratio	-0.1086757	0.0339689	-3.20	0.003***	[-0.1776362, -0.0397151]
NPL	-0.0751341	0.0403420	-1.86	0.071*	[-0.1570326, 0.0067645]
CAR	-0.0073496	0.0097333	-0.76	0.446	[-0.0275933, 0.0128941]
PCC	0.0006859	0.0001671	4.10	0.000***	[0.0003467, 0.0010253]
CIR	-0.0051076	0.0042742	-1.19	0.240	[-0.0137647, 0.0035496]
Ln_Asset	-0.1959016	0.0237617	-8.24	0.000***	[-0.2441405, -0.1476628]
_cons	3.077814	0.3687193	8.35	0.000***	[2.329271, 3.826357]

Levels of significance : *, **, *** correspond to the 10%, 5%, and 1% levels, respectively.

The regression results are shown in Table 3. The coefficient for the core explanatory variable, the green credit ratio, is -0.1087, which is significantly negative at the 1% significance level ($P = 0.003$), indicating that an increase in the green credit ratio has a significant inhibitory effect on bank profitability. Specifically, holding other factors constant, a 1 percentage point increase in the green credit ratio is associated with an average decrease of approximately 0.109 percentage points in the bank's return on assets (ROA). This result reflects the challenges associated with green credit, such as longer return cycles and higher risk identification costs in the short term, which negatively impact bank profitability.

In terms of control variables, the coefficient of the non-performing loan ratio (NPL) on ROA is -0.0751, approaching the 10% significance level ($P=0.071$), indicating that an increase in non-performing loans erodes banks' profit margins, consistent with both empirical observations and theoretical expectations. The regression coefficient for the provision coverage ratio (PCC) is 0.0007, which is positive at the 1% significance level ($P < 0.001$), indicating that banks with adequate provisions have stronger risk-bearing capacity and more stable profitability. The coefficient for bank asset size is -0.1959, which is significantly negative at the 1% significance level ($P < 0.001$), suggesting that as bank size increases, profitability may decline, potentially due to rising management costs and reduced resource allocation efficiency resulting from scale expansion. The regression results for capital adequacy ratio (CAR) and cost-to-income ratio (CIR) are not significant, meaning that these two factors have a limited impact on bank profitability or fail to reach statistical significance within the current sample.

Overall, the model's R^2 (within) is 0.5858, indicating that the explanatory variables collectively explain approximately 58.6% of the within-firm variability in bank ROA. Additionally, the model passed the F-test ($F=25.91$, $P<0.01$), indicating that the overall model has strong statistical explanatory power. The above benchmark regression results validate that the development of green credit business does indeed significantly suppress banks' short-term profitability, providing a reliable foundation for subsequent heterogeneity analysis and the identification of policy impacts.

To ensure the stability of the regression model and the reliability of the results, this paper conducted multicollinearity tests on all variables in the regression using the variance inflation factor (VIF) method. As shown in Table 3, the VIF values for all variables in the model are far below the critical threshold of 10. The highest VIF value is 2.34 for the provision coverage ratio (PCC), followed by 2.23 for the non-performing loan ratio (NPL), while the VIF value for the core explanatory variable, the green credit ratio, is only 1.08. Furthermore, the model's mean VIF figure stands at 1.53, significantly lower than the 10-point multicollinearity limit, suggesting an absence of notable multicollinearity between the chosen explanatory and control

variables in this research. Consequently, the outcomes of the regression analysis are dependable and serve as a basis for further examination and discussions on policy suggestions.

4.4. Heterogeneity Analysis

This study categorizes the sample into three types of banks - state-owned, joint-stock, and city commercial - to delve deeper into the varied effects of green credit on banking profitability. Within every sub-sample, fixed-effects models are developed, with the outcomes of the regression analysis displayed in Table 4.

Analysis of regression for state-owned banks reveals that the key explanatory factor, the green credit ratio, influencing bank profitability, has a coefficient of -0.1109, markedly negative at the 5% significance threshold ($P=0.024$). This suggests that with each one percent rise in the green credit ratio of government-owned banks, there's an average reduction of about 0.111 percentage points in their asset returns. This indicates that government-run banks face a more substantial policy load regarding green credit, with the financial and risk management strains stemming from the short-term growth of their green credit operations being considerably more intense, thus greatly diminishing their profit margins.

The results for joint-stock banks show that the coefficient for the green credit ratio is 0.5506, with a positive direction, but it does not reach statistical significance ($P=0.119$). This suggests that the impact of green credit business on profitability is not significant for joint-stock banks, possibly because they have stronger market-oriented decision-making mechanisms in expanding green finance business, as well as robust risk identification and profitability management capabilities, which may allow the profitability effects of their green credit business to gradually emerge or remain temporarily uncaptured by the model.

Analysis of the regression for urban commercial banks reveals a negative coefficient of -0.1014 for the green credit ratio ($P=0.139$), suggesting a less pronounced inhibitory impact of green credit on city commercial banks' profitability compared to state-owned banks, which lacks statistical significance. This may be related to the relatively low green credit ratio of city commercial banks, lighter policy tasks, and relatively controllable green credit risks, resulting in limited short-term profitability impacts.

Table 4. Heterogeneous Analysis of the Impact of Various Types of Green Loans on Profitability

Bank type	Coefficient	p-value
state-owned bank	-0.1109	0.024**
joint-stock bank	0.5506	0.119
city commercial bank	-0.1014	0.139

4.5. Policy Impact Analysis

Table 5 illustrates the DID results for different bank types, revealing that the interaction term's coefficient ($did1$) is negative (-0.047), yet it lacks statistical significance ($P=0.323$). This indicates that the adoption of the green credit policy in 2016 had minimal impact on the profit margins (ROA) of state-owned banks, especially those with higher green credit ratios versus those with lower. One plausible explanation could be the extensive scale of state-owned banks, where variations in green credit operations exert minimal influence on their overall profit margins, thus diminishing the impact of policy.

The interaction term's coefficient ($did2$) for joint-stock banks shows a notable positive trend (0.178, $P=0.041$), signifying that post the green credit policy's introduction, joint-stock banks with elevated green credit ratios experienced a substantial increase in profitability in contrast to those with lower ratios. This may suggest that under policy incentives, joint-stock banks have

adopted more flexible and proactive strategies in their green credit business, effectively converting policy benefits into actual profit growth.

The coefficient of the interaction term (did3) for city commercial banks is positive (0.048) but not significant (P=0.440). This suggests that after the policy implementation, there was no significant change in the profitability of city commercial banks with high green credit ratios compared to those with low ratios, and the policy did not exhibit a noticeable differentiated impact. This may be due to the relatively small scale of green credit and high market concentration among city commercial banks, making it difficult for policy effects to manifest clearly in the short term.

In summary, joint-stock banks responded significantly positively to the green credit policy, actively expanding their green business operations, with clear policy effects. State-owned banks and city commercial banks did not show significant policy responses. This suggests a substantial diversity in how the green credit policy affects various banking institutions. Regarding policy consequences, there's a need for additional refinement in policy formulation, differentiating the traits of various bank categories, particularly enhancing precise incentives for the green transformation of state-owned and city commercial banks.

Table 5. DID results for different types of banks

Bank type	Coefficient	Std. Err.	p-value
state-owned bank	-0.0471	0.043	0.323
joint-stock bank	0.1782	0.073	0.041**
city commercial bank	0.0482	0.061	0.440

4.6. Robustness Check

4.6.1. Replace Core Explanatory Variables

Table 6 presents regression estimates in which the green credit ratio is replaced by the natural logarithm of green credit balance (Ln_green), to evaluate its robustness as the key explanatory variable. Findings reveal the Ln_green coefficient to be -0.042, a statistically significant figure at the 5% level, signifying that the growth in green credit balances continues to inhibit bank profitability (ROA), thus confirming the main regression results' solidity. Additionally, control variables such as NPL, PCC, and Ln_Asset remain significant and consistent in direction, indicating that the model estimates are reliable.

Table 6. Regression results for the logarithm of green credit balance

Variable	Coefficient	Std. Err.	t-value	p-value
Ln_green	-0.0422085	0.0186978	-2.26	0.03**
NPL	-0.0826007	0.0361991	-2.28	0.029**
CAR	-0.0093393	0.0097649	-0.96	0.362
PCC	0.0006706	0.0001438	4.66	0.0***
CIR	-0.0045532	0.0041717	-1.09	0.283
Ln_Asset	-0.1064452	0.0248321	-4.29	0.0***
_cons	2.443545	0.434222	5.63	0.0***

4.6.2. Exclude Samples from the Year of the COVID-19 Pandemic

As indicated in Table 7, this study omits 2020 and 2021 data to adjust for the COVID-19 pandemic's effect on bank profitability and conducts a re-analysis of the regression. Findings indicate the green credit ratio's coefficient stands at -0.133, a statistically significant figure at the 1% significance threshold and consistently negative, further confirming the inhibitory effect of green credit expansion on bank profitability. The control variables align with the main

regression results, indicating that the regression model demonstrates robust stability in sample handling.

Table 7. Regression results excluding the year of the COVID-19 pandemic

Variable	Coefficient	Std. Err.	t-value	p-value
Greencredit_Ratio	-0.133	0.0378	-3.52	0.001***
NPL	-0.0733	0.0375	-1.95	0.059*
CAR	-0.0044	0.0152	-0.42	0.677
PCC	0.0007	0.0002	3.81	0.001***
CIR	-0.0074	0.0049	-1.49	0.144
Ln_Asset	-0.1944	0.2597	-7.48	0.0***
cons	3.1335	0.4143	7.56	0.0***

5. Conclusion

Amidst the continuous execution of the 'dual carbon' strategy and eco-friendly development policies, green credit emerges as a crucial route for commercial banks to attain sustainable growth. The study employs panel data from Chinese A-share listed commercial banks between 2007 and 2023, using fixed effects and DID models to methodically assess green credit's effect on bank profits, and also investigates policy impacts and the diversity of bank types.

Findings from the study reveal a notable inverse relationship between the amount of green credit and the profitability of banks (ROA), indicating that green initiatives are presently hindered by issues like extended return periods and challenges in recognizing risks, potentially leading to short-term reductions in bank profits. (2) Post the release of the 'Guiding Opinions on Building a Green Financial System' in 2016, joint-stock banks exhibited a slight yet notable enhancement in profitability due to policy incentives, showcasing robust policy adaptability and effectiveness in the growth of green businesses. (3) Diverse bank types exhibit a range of policy reactions. Post-policy implementation, there was no notable enhancement or even a minor decline in the profits of state-owned banks, in contrast to city commercial banks which exhibited a trend of improvement but lacked statistical significance, indicating ongoing challenges for small and medium-sized banks in managing green credit and allocating resources. To more effectively leverage the positive role of green credit in promoting bank sustainability, the following policy recommendations are proposed:

Strengthen differentiated policy incentive mechanisms: Develop targeted green credit incentive schemes for banks of different natures, with particular emphasis on supporting small and medium-sized banks, such as establishing green risk compensation funds or providing interest subsidies for green loans, to enhance their capacity for green business development. **Promote performance-oriented regulation of green credit:** Incorporate green finance into banks' comprehensive performance evaluations to encourage banks to expand their green business while maintaining risk control, thereby fostering a healthy competitive mechanism.

While this study thoroughly investigates how green credit affects bank profits through diverse empirical approaches, certain limitations remain. First, green credit indicators are not broken down to the specific industry or project level, making it difficult to reveal the impact of structural differences in green loans. Second, the research sample primarily consists of listed banks, failing to cover rural financial institutions or non-listed small and medium-sized banks, limiting its generalizability. Additionally, policy identification primarily relies on the 2016 time point; future research could combine regional or phased policies to further enhance policy identification accuracy.

Future research could integrate data on the quality of green loan disbursements, carbon emission reduction effects, and ESG ratings to further explore the pathways through which green finance influences bank performance, thereby providing more comprehensive micro-level evidence and policy basis for the high-quality development of green finance.

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Appendix

Variance Inflation Factor (VIF) Test Results

Variable	VIF	1/VIF
PCC	2.34	0.428084
NPL	2.23	0.448875
CAR	1.24	0.807679
Ln_Asset	1.17	0.851737
CIR	1.11	0.899245
Greencredit_Ratio	1.08	0.922921
Mean VIF	1.53	