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The Impact Of Green Credit Policy On The Operating Performance Of Commercial Banks

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Abstract:
With the quick development of China's economy, the traditional extensive growth model has resulted in severe environmental issues, increasingly highlighting the conflict between economic growth and ecological conservation. Against this backdrop, adjusting the original development model, fostering the enhancement and refinement of the economic framework, and adopting low-carbon, environmentally friendly green development strategies have become particularly urgent for China. To align with this trend, green finance has emerged as a mechanism to support sustainable development by leveraging the capital-guiding role of the financial sector, among which green credit stands out as one of the critical financial instruments garnering considerable attention. Based on data from a report by the People's Bank of China, between the end of 2013 and the end of 2018, the balance of green loans provided by 21 major banks in China increased from 5.2 trillion yuan to 9.66 trillion yuan, reflecting a continuous upward trend in the scale of green lending. Additionally, there is a significant variation among banks in terms of their level of enthusiasm for adopting green credit initiatives.Given that the primary objective of commercial banks is profitability, and green credit projects are often associated with higher initial costs and lower rates of return, concerns have been raised regarding whether engaging in such business may negatively impact banks' financial performance. Therefore, this research intends to explore the effect of green credit policies on the financial performance of commercial banks. By using panel data spanning from 2007 to 2022 for 30 state-owned, joint-stock, and urban commercial banks in China and applying a multi-period difference-in-differences approach for empirical analysis, the findings indicate that green credit policies substantially improve the commercial banks' performances.This research provides valuable insights into how green credit initiatives can be effectively integrated into the banking sector to foster both financial prosperity and environmental sustainability.

Keywords: *green credit policy, enterprise performance, The multi-time period difference-in-differences model*

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I. Introduction

As the "dual carbon" goals progressively become the core driving force for promoting green economic development in China, they not only aid in enhancing and modernizing industrial frameworks ,but also serve as critical benchmarks for achieving high-quality development. Against this backdrop, green finance is experiencing unprecedented opportunities for growth. The Chinese government prioritizes the promotion of green and low-carbon development as a strategic focus, continuously delving into research within the realm of transition finance, and is dedicated to establishing an effective bridge between green finance and transition finance. This endeavor aims to formulate a series of practical and guiding policy measures.

Data up to the end of 2021 indicate that China's balance of green credit has risen to 15.1 trillion yuan, marking a significant increase from 5 trillion yuan in 2012. This achievement is primarily attributed to the active guidance of the government's green credit policies and financial support from financial institutions. However, focusing on specific banks' green credit data reveals that green credit constitutes less than 10% of total loans, indicating that enthusiasm for engaging in green credit business among banks and other financial institutions remains to be enhanced.

In this scenario, it becomes especially important to examine the effect of introducing green finance on the profitability of the banking sector. Understanding this relationship is vital for advocating for enduring expansion of green finance and constitutes a key focus for future policymakers and financial institutions. This approach not only serves to enhance the enthusiasm of financial institutions in participating in green credit but also contributes to achieving more environmentally friendly and sustainable development goals.

II. Literature Review

The research on green credit policy

Research on green credit policies can primarily be divided into international and domestic perspectives. In the international literature, Li et al. (2018)[1] analyzed the strategic interactions among enterprises, financial institutions, and government departments in promoting technological innovation through green credit, examining the effect of eco-friendly credit and policy support on incentivizing clean production activities. The research indicated that government-provided green credit subsidies have the potential to enhance the environment by diminishing emissions of corporate pollutants. Additionally, these subsidy measures not only stimulated companies' enthusiasm for technological innovation but also increased uncertainties during the innovation process. Thompson and Cowton (2004)[2] investigated the relationship between bank loans and environmental information requirements, finding that UK banks incorporate environmental factors into loan assessments, thus affecting lending decisions and scales. Flammer (2020) [3]studied corporate green bonds, demonstrating that issuing green bonds drives companies towards environmentally friendly development and enhances environmental awareness.

In domestic literature, Xu Xuejun and Qi Qiuyue (2022) [4] investigated the effect of eco-friendly policies on firms' access to financing, noting that following the implementation of these policies, the cost of financing for heavily polluting industries significantly increased, their capacity for long-term debt financing slightly decreased, and there was a minor improvement in short-term debt financing. Meanwhile, Wu Lichao et al. (2022) [5] utilized a difference-in-differences method to assess the effect of eco-friendly policies on green technological innovation in export companies across both polluting and non-polluting industries. Their findings revealed that since enacting eco-friendly credit strategies, export firms in polluting sectors have shown a significant decrease in green technological innovation. Additional studies have also underscored the intermediary role of financing costs in this dynamic, suggesting that green credit policies indirectly affect green technological innovation activities by influencing these costs.

Tian Lulu et al. (2023)[6] found the effect of eco-friendly credit on the quality of manufacturing exports by analyzing matched information sourced from the Chinese industrial enterprise and customs databases spanning 2004 to 2013.The results indicated that green credit promotes the quality of manufacturing exports mainly through two channels: encouraging increased R&D investment and alleviating financing constraints, with varying degrees of impact observed across different enterprises, industries, and regions. Han Guogao (2024)[7] explored the effect of green credit policies on the range of products exported by enterprises, showing that such policies particularly reduce the product range of high-pollution enterprises, especially in cities with higher levels of environmental information disclosure and stricter environmental regulations, as well as in companies with high debt leverage and state-owned enterprises. Hu Dingyan et al. (2024)[8] found that green finance inhibits the export technological complexity of heavily polluting enterprises, partly through its impact on firm performance, with a greater effect observed in small-scale and non-state-owned enterprises.

Research on the impact of green credit on commercial bank performance

Regarding the impact of commercial banks' implementation of green credit policies on operational performance, insights from international literature suggest mixed findings. Some studies indicate that banks implementing green credit may face reduced returns due to increased environmental assessment costs for projects. For instance, Marcel Jeucken (2001)[9] proposed that a bank's path towards sustainability can be divided into four stages: Defensive, Preventive, Offensive, and Sustainable. Currently, most banks remain in the first two stages, where environmental protection measures might lead to increased costs and decreased profits. However, numerous studies also highlight positive impacts of green credit on bank performance, suggesting long-term benefits. Chamie et al. (2002) [10]argued that financial institutions actively expanding their green credit portfolios and increasing the proportion of green finance in investment and financing activities not only enhance their social reputation but also strengthen risk management.

Nevertheless, research by Galema (2008) [11]indicates that the impact of fulfilling social responsibilities on financial institutions' operational risks and return levels is not significant due to the diversity of financial products and variations in investor demand. Li Shuangshuang (2015)[12], through comparative analysis of data from Chinese commercial banks, found that the introduction of new green financing products significantly enhanced bank performance. Conversely, some scholars have pointed out from a cost-benefit perspective that green credit could increase operational costs in the short term, adversely affecting the performance of commercial banks (Ma Ping et al., 2009)[13]. Hu Rongcai (2016)[14] suggested, however, that expanding the scale of credit could offset profit losses incurred by adopting green credit practices.

III. Research Design

Data resource

The"Green Credit Guidelines" were released by the China Banking Regulatory Commission (CBRC) in 2012, acting as a crucial directive to steer the progression of green credit within the banking sector and marking a novel phase in China's evolution of green credit methods.However, given the inherent lag in policy implementation,Chinese commercial banks began engaging in green business activities as early as 2008, albeit at different times. Considering the need for continuity and accessibility of bank-reported data, this study adopts the period from 2008 to 2022 for analysis.

This study employs data from 30 Chinese commercial banks spanning from 2008 to 2021, comprising 6 major state-owned commercial banks, 9 joint-stock commercial banks, and 15 city commercial banks.The sample encompasses both listed and unlisted banks, providing comprehensive coverage of all types of commercial banking institutions in China and effectively reflecting the overall status of the banking sector. The data used are comprehensive and representative, sourced from the CSMAR database and annual reports published by the respective banks. This approach ensures a thorough examination of the effect of green credit policies on the performance of commercial banks in China.

Variable selection

Explained variable

To investigate how green credit policy influences the commercial banking sector's performance, this study selected specific variables for analysis. Return on total assets (ROA) is used as the dependent variable to represent the financial condition of commercial banks, with higher ROA values indicating greater profitability. The study utilizes ROA data from each bank's annual reports as the evaluation criterion.

Explanatory variable

This study incorporates variables such as time dummy, sample dummy, and policy effect variables. Taking into account the varying timelines for commercial banks to develop and implement green credit initiatives, a multi-period difference-in-differences model is adopted as the primary method to assess the policy impacts of green credit [15,16,18,20]. Depending on when banks initiate the green credit policy, the time dummy variable receives a value of 0 if the present year comes before the policy's active phase, and 1 in all other cases.The sample dummy variable distinguishes whether banks have adopted green credit policies, with banks that have implemented the policies marked as 1 and those that have not as 0, thereby controlling for potential effects of policy adoption on bank performance. The policy effect variable is derived by multiplying the time dummy and sample dummy variables. As the key variable in this study, its coefficient in the regression analysis helps quantify the specific effect of eco-friendly credit policies on banks' operational performance.

Control variable

With reference to existing literature, this paper selects non-performing loan ratio, capital adequacy ratio and liquidity ratio as control variables.

The non-performing loan ratio (NPL) is defined as the proportion of non-performing loans to total loans, serving as a critical indicator for assessing the credit asset quality of commercial banks. A higher ratio indicates a larger share of loans that banks are unable to recover, negatively impacting their profitability. Consequently, this study selects the non-performing loan ratio as a control variable.

Liquidity ratio (LR). Liquidity ratio reflects the strength of the bank's short-term solvency and is an important index to measure the bank's liquidity risk. A higher liquidity ratio means that banks have more liquid assets to meet potential funding needs, which helps reduce the liquidity risk faced by banks. However, an excessively high liquidity ratio can also indicate that a bank is not using its assets efficiently, as excess liquid assets typically yield lower returns.

The Capital Adequacy Ratio (CAR) is characterized as the proportion of a bank's overall capital relative to its risk-adjusted assets, and aims to assess the ability of commercial banks to use their capital to withstand potential losses when facing financial difficulties. Improving the capital adequacy ratio helps to strengthen the risk prevention and control ability of banks and promote their healthy development. However, higher capital requirements could also result in banks needing to maintain higher capital levels, which could adversely affect their profitability to some extent.

Model design

The multi-time period difference-in-differences model

The principle of the differential model is to make the difference between the experimental group and the control group, that is, first calculate the data of the two groups respectively in the group, calculate the difference value of the explained variable before and after the implementation of the policy, and then make the difference

again between the experimental group and the control group before and after, to obtain the multiple difference value. The difference between the multi-phase differential method and the traditional differential method is that all samples in the traditional DID processing group have only one policy impact point, while the multi-phase DID is impacted at multiple policy impact points, which can more effectively analyze the real policy effects before and after the impact of different individuals[17,23,24].

Based on this, a multi-time point differential model is constructed. Due to the time-staggered nature of commercial banks' promotion of green credit business, this model can effectively avoid other factors affecting the measurement of green credit policy effect.

The fundamental regression model developed in this research is outlined below:

$$ROA_{it} = \alpha_0 + +\alpha_1 did_{it} + control + \mu_i + \gamma_t + \varepsilon_{it}$$

Where i represents different commercial banks; t means different years; Control individual fixed effect, control time fixed effect; It's the error term. The policy variable that represents the impact of individual i by the policy of the t period is treat*post, and its coefficient reflects the policy effect of multi-period DID[19,21,22,23].

IV. Empirical Research And Analysis

Data analysis and related inspection

Descriptive statistics

Table 1
Descriptive statistics

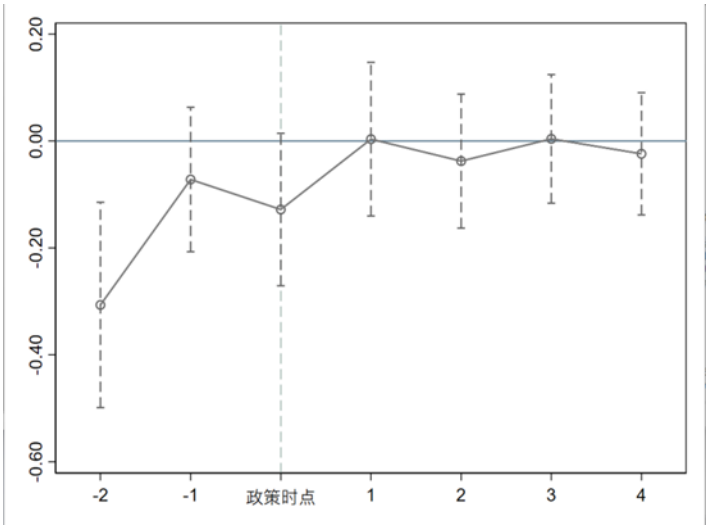
VarName	Obs	Mean	SD	Median	Max	Min
ROA	473	0.948	0.397	0.940	2.740	0.050
DID	480	0.431	0.496	0.000	1.000	0.000
NPL	417	1.567	1.854	1.420	28.440	0.320
LR	358	51.217	13.337	49.850	106.620	26.800
CAR	412	12.521	2.336	12.390	19.260	-11.040

Table 1 displays the detailed statistical data for the principal variables.The mean value of return on total assets (ROA) is 0.948, with a variance of 0.397, suggesting that the performance levels of the sampled commercial banks are relatively similar.The mean value and variance of the explanatory variable did were 0.431 and 0.496, indicating that the did of the sample enterprises varied greatly. Among the control variables, the gap between the maximum and minimum value of liquidity ratio (LR) is the largest, while its mean and standard deviation are also the largest, reflecting the large fluctuation of the overall liquidity ratio of the sample commercial banks. The difference between the maximum and minimum non-performing loan ratio (NPL) is the smallest, and its mean and standard deviation are also the smallest, reflecting the balance of the overall non-performing loan ratio of the sample commercial banks.

Parallel trend test

When employing a difference-in-differences (DID) model to assess policy effects, it is essential first to validate the parallel trends assumption, which posits that all subjects in the sample should exhibit similar trends before the policy's implementation. If the regression results are not significant before the policy intervention but become significant afterward, this indicates that the parallel trends assumption holds. Since passing this test is a prerequisite for applying the DID model, it should be conducted prior to empirical regression analysis. In this study, the observation period was set from two years before the policy implementation to four years after. The analysis reveals that following the policy's introduction, the coefficient shifted from being significantly negative to non-significant, with the most pronounced change occurring in the first year post-implementation.This indicates that the implementation of the eco-friendly credit policy markedly influenced the functioning of commercial banks post-introduction.

Figure 1
Parallel trend test



Empirical results and analysis

Baseline regression result

As shown in Table 2, the regression results are detailed. Models (1) and (2) focus on the influence of green credit policy enactment on bank performance during the same year, with Model (1) lacking additional control variables.

For this study, the interaction term between the time dummy variable and the policy dummy variable was used as the explanatory variable in the regression analysis. Preliminary findings show that, when control variables such as liquidity ratio (LR), capital adequacy ratio (CAR), and non-performing loan ratio (NPL) are excluded, the explanatory variable's coefficient shows a notable positive value at a significance threshold of 1%, indicating a beneficial impact on the dependent variable. After incorporating the control variables, the coefficient is adjusted to 0.175, yet it remains significantly positive at the 1% level. These results confirm the hypothesis proposed in this paper: the introduction of green credit policies has led to noticeably better performance in commercial banks that adopted these policies compared to those that did not.

Table 2
Baseline regression result

	(1)	(2)
	Roa	Roa
Did	0.213***	0.175***
	(4.150)	(3.289)
Npl		-0.097***
		(-4.598)
Lr		0.001
		(0.902)
Car		0.021***
		(2.883)
_cons	0.857***	0.686***
	(35.578)	(6.312)
Id	YES	YES
Year	YES	YES
N	473	350
Adj. R2	0.734	0.810

*p < 0.1,**p<0.05,***p<0.01.

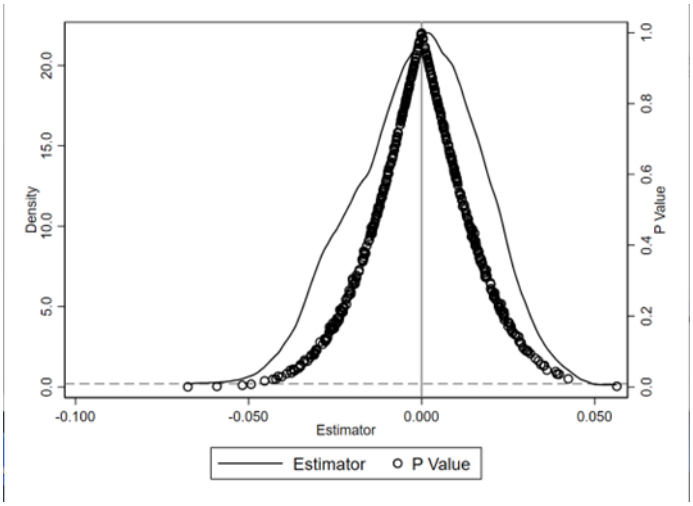
Robustness test

In order to better verify the robustness of the empirical results, this paper uses the placebo test, deletion of abnormal years and PSM-DID methods to conduct robustness tests.

Placebo test

Figure 2 shows the results of the placebo test, from which it can be observed that the estimated coefficients are concentrated near zero and have the characteristics of a normal distribution, which is consistent with the expectations of the placebo test. The probability that the coefficient results equal to the main effect of 0.175 in this paper approaches 0, so the test passes. It shows that the empirical results are robust[24,25].

Figure2
Placebo test



Delete abnormal year

Table 3
Removes the anomaly year robustness test

	(1)
	Roa
Did	0.130**
	(2.528)
Npl	-0.068***
	(-3.145)
Lr	-0.001
	(-1.205)
Car	0.003
	(0.343)
_cons	1.069***
	(9.438)
Id	YES
Year	YES
N	275
Adj. R2	0.820

*p < 0.1,**p<0.05,***p<0.01.

In this context, the abnormal years are deleted from the data, and the model is analyzed again by difference-difference analysis.The findings indicate minimal alteration in the importance of explanatory variables. It can be seen that the empirical results are robust.

PSM-DID test

Given that commercial banks implementing green credit policies may exhibit systematic differences from those that do not, leading to potential non-comparability between the treatment and control groups, this study further employs the PSM-DID (Propensity Score Matching - Difference in Differences) method to mitigate bias caused by non-random selection. All control variables are incorporated as covariates, and the propensity scores for each commercial bank adopting green credit policies are estimated using a Logit model. Subsequently, based on these propensity scores, a 1:4 nearest neighbor matching method is applied to match each treated bank (those implementing green credit policies) with control banks (those not implementing green credit policies) that have

similar characteristics across all observed dimensions. Finally, using the matched sample, the model is re-estimated, and the regression results, as shown in Table 4, indicate that the impact of green credit policies on the performance of commercial banks remains significantly positive. This approach ensures a more accurate assessment of the causal effect of eco-friendly credit policies on bank performance by addressing potential selection biases.

Table 4
PSM-DID test

	(1)
	roa
did	0.169***
	(2.892)
npl	-0.104***
	(-4.499)
lr	0.001
	(1.061)
car	0.013*
	(1.701)
_cons	0.781***
	(6.995)
Id	YES
Year	YES
N	284
Adj. R^2	0.822

*p < 0.1,**p<0.05,***p<0.01.

Heterogeneity analysis

Taking into account the ownership structure of commercial banks, which can be categorized as either state-owned or non-state-owned, the sample has been divided into state-owned and non-state-owned banks for subgroup analysis according to the model. As indicated in Table 5-5, green credit policies have a positive impact on the performance of both groups. Nevertheless, the positive effect on the profitability of state-owned commercial banks is more pronounced, reaching significance at the 1% level. This could be attributed to several factors: on one hand, state-owned commercial banks are more public-oriented and bear greater social responsibilities, leading them to invest significantly more in green credit activities compared to non-state-owned banks. Although this may result in larger cost-benefit pressures in the short term, the extensive scale of green credit operations by nationwide state-owned banks occupies a substantial portion of the market, thereby significantly enhancing their profitability. On the other hand, non-state-owned commercial banks have relatively later adoption and less thorough implementation of green credit policies. Their market activity volume in green credit is much lower than that of state-owned banks, resulting in a less significant impact on improving profitability within a short period.

This nuanced analysis highlights the differential impacts of green credit policies on state-owned versus non-state-owned commercial banks, reflecting variations in policy execution depth, market presence, and strategic focus on corporate social responsibility.

	(1)	
	state-owned	non-state-owned
did	0.265***	0.111
	(2.785)	(0.963)
npl	-0.192***	-0.079
	(-5.974)	(-1.557)
lr	0.000	0.002
	(0.225)	(0.810)
car	0.010	0.074***
	(1.163)	(3.656)
_cons	0.954***	0.042
	(6.932)	(0.140)
Id	YES	YES
Year	YES	YES
N	172	115
Adj. R^2	0.800	0.853

*p < 0.1,**p<0.05,***p<0.01.

V. Conclusion

In this research, panel data from 30 domestic commercial banks spanning from 2007 to 2022 are employed, and a multi-period difference-in-differences (DID) model is used to evaluate the impact of green credit policies on the operational performance of banks.The results suggest that such strategies significantly enhance the functioning efficiency of business banks.Further heterogeneity analysis highlights that state-owned banks see a greater increase in profitability—at the 1% significance level—compared to non-state-owned banks. This suggests that the adoption of green credit policies yields more substantial profitability improvements for state-owned banks than for those not under state ownership.

Recommendations

Drawing from the previously mentioned studies, we suggest the subsequent suggestions:

1. Government and Regulatory Authorities: Should focus on further refining green credit policies and related laws and regulations, optimizing operational procedures for green credit businesses, and strengthening regulatory systems. These efforts aim to promote the scale of green credit business development, effectively reduce costs, and thereby enhance the operating performance of commercial banks.
2. Commercial Banks: Need to actively expand their involvement in green credit business areas and develop innovative green credit products. This not only helps in increasing the social recognition and brand reputation of the banks but also contributes to environmental protection efforts.
3. Utilization of Media Influence: Commercial banks should fully leverage the extensive influence of media to promote their green credit businesses through various channels. By proactively taking on social responsibilities, they can cultivate a positive green corporate image, thus building and enhancing their competitive market advantages. This dual approach not only fosters environmental sustainability but also establishes a sense of responsibility and commitment in the public eye.

Ethical Statement

The study excludes any human or animal subject-related research carried out by the authors.

Conflicts of Interest

The writers affirm the absence of any conflicting interests associated with this study.

Data Availability Statement

The data supporting the findings of this study are publicly accessible in CSMAR at https://data.csmar.com.

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