



The Impact of Green Finance on Commercial Bank Profitability: An Empirical Analysis Based on Chinese Commercial Banks

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Abstract. As global environmental issues and the contradiction between development and the carrying capacity of resources and the environment become increasingly prominent, the development of green finance has become an inevitable choice for achieving coordinated economic and environmental development. Sustainable finance leverages specialized instruments like eco-friendly loans to drive economic decarbonization. This approach has become an essential strategy for facilitating the shift in national development paradigms and accelerating industrial modernization toward environmentally conscious practices. The sector represents both an innovative financial mechanism and a critical response to pressing global ecological challenges. Green finance extends beyond environmental benefits, significantly influencing commercial banks' profitability and operational frameworks. This study investigates how green finance influences bank profitability by compiling and evaluating data from 14 Chinese banks from 2014 to 2022. The sample includes the "Big Five" state-owned banks (ICBC, ABC, BoC, CCB, and BoCom) alongside joint-stock commercial banks like China Merchants Bank and SPDB, which examines how green finance initiatives influence the profitability of these banking institutions. Empirical findings reveal a U-shaped link between green finance and bank profitability. While green finance may temporarily reduce bank profits, it enhances long-term financial performance. With these insights, the research presents pertinent suggestions to both the administration and private lenders for fostering eco-friendly financial strategies. This study offers data-driven insights and conceptual backing for sustainable finance transformation.

Keywords: green finance; commercial bank profitability; U-shaped relationship

1 Introduction

Against the backdrop of escalating global climate crises and the deepening of sustainable development concepts, green finance has emerged as a core tool for driving economic low-carbon transformation and has become a key direction for reform within China's financial system [1]. At the close of 2022, China's outstanding

green credit denominated in both domestic and foreign currencies stood at 22.03 trillion yuan, representing a 38.5% increase compared with the previous year and constituting 9.5% of total financial institution lending [2]. Commercial banks, as the main force in green finance, play a crucial role in guiding capital flows toward low-carbon industries and supporting the implementation of the ‘dual carbon’ strategy. Despite being driven by both policy support and market demand, commercial banks still face challenges in green finance practices, including the lack of unified standards [3], high initial costs, and a shortage of talent. While the expansion of green finance can help commercial banks optimise their asset structures, issues such as high costs, high risks, and policy implementation deviations may temporarily hinder improvements in profitability[4].Hence, the paper delves into the ever-evolving connection between commercial banks' sustainable financing practices and their earnings potential, merging real-life case studies with empirical data to thoroughly examine this intricate topic. The aim is to provide theoretical support and practical references for policymakers to optimise incentive mechanisms and for commercial banks to balance social responsibility with economic benefits. The paper is organized into distinct sections, with the second one serving as a thorough literature review. The third section outlines the research methodology, while the fourth delves into the empirical analysis. The final section provides a synthesis of the study's results.

2 Literature Review

2.1 The Impact of Green Finance on Commercial Bank Profitability

Green finance's emergence significantly influences the operations of commercial banks, presenting both opportunities and challenges for them. International researchers contend that adopting green credit practices enhances commercial banks' financial outcomes [5], but also helps to enhance the bank's social reputation and competitiveness. Some experts argue against the prevailing consensus, contending that green finance's extended time horizon clashes with banks' focus on immediate returns [1]. They further maintain that, in the short run, sustainable banking practices may actually undermine financial institutions' bottom line[6]. Among them, Guo Wenwei and Liu Yindi (2019) found that while green credit increases banks' costs in the short term, it helps optimise credit structure in the long term, laying a solid foundation for bank profitability [7].

2.2 Literature Review

A review of relevant literature has provided important insights for this study. Overall, researchers globally concur that green finance facilitates the greening of banking and fosters sustainable progress. However, studies on green finance's effect on bank profitability remain inconclusive.

Previous literature has primarily focused on linear relationships, which are somewhat one-sided. This study employs a method of squaring key variables to verify whether a U-shaped relationship exists. Additionally, by gradually adding variables

during benchmark regression, the robustness of the conclusions is significantly enhanced.

3 Research Design

3.1 Variable Selection and Data Sources

The profitability of commercial banks is the result of multiple factors. Based on an interpretation of relevant literature and an analysis of previous research findings, the following variables were selected for this study:

1. Dependent Variable

Return on assets (ROA) evaluates commercial banks' profitability and business model stability.

The formula is as follows:

$$\text{Return on Assets (ROA)} = \text{Net Profit} / \text{Total Assets}$$

2. Explanatory Variables

Although Chinese commercial banks currently have access to various green financial tools, most of the data is not publicly available.

Additionally, considering the impact of differing scales among various types of commercial banks on the analysis, the Green Credit Ratio (GCL) was ultimately selected as the explanatory variable in this model. Its formula is as follows:

$$\text{Green Credit Ratio} = \text{Green Credit Balance} / \text{Total Loans}$$

3. Control Variables

Based on the main factors and mechanisms influencing commercial bank profitability discussed in this paper, it is evident that numerous factors impact commercial bank profitability. This paper selects the following three variables as control variables for the model:

The CAR is a measure that compares a bank's core capital against its risk-weighted assets. Its calculation is given by:

$$\text{Capital Adequacy Ratio} = \text{Bank Capital} / \text{Risk-Weighted Assets}$$

A bank's loan-to-deposit ratio (LDR) measures the proportion of its total loans relative to its deposit base. When maintained within regulatory limits, an elevated LDR typically signals greater earning potential for the institution. This financial metric can be calculated using the following equation:

$$\text{LDR} = \text{Loan Balance} / \text{Deposit Balance}$$

Total Assets (TA) refers to the total assets of a commercial bank. Since the total assets of commercial banks are massive, it is not conducive to statistical analysis in the model. To facilitate research simplicity, the study employs the logarithmic transformation of total assets as the control variable.

3.2 Data Sources

This paper selects a total of 14 listed commercial banks as the research subjects, which basically cover all types and regions of commercial banks in China. Data are obtained from Guotai An CSMAR, Wind, and banking company annual publications.

3.3 Model Setup

After choosing the indicators, a multiple linear regression model evaluates how green finance affects bank profitability:

$$Y = \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + \beta_0 + \varepsilon \quad (1)$$

In this regression model, Y serves as the measure of commercial banks' profitability, while $x_1, x_2, \dots, x_n$ denote the explanatory variables, encompassing both green finance metrics and control factors. β_1 through β_n indicate the correlations between every predictor and the target variable, β_0 represents the constant term, and ε accounts for unexplained variability or random noise in the data.

3.4 Descriptive Statistics of Variables

Table 1 reveals that the standard deviation for green credit is quite substantial at 6.666, nearly matching the mean value. Despite this, there's still a notable spread between the highest and lowest figures, with the range stretching from a modest 0.500% to a more significant 1.467%.

indicating that there are significant differences in resource allocation and strategic emphasis in the field of green finance among different banks. The average profitability is 0.987%, with a standard deviation of 0.198, showing manageable fluctuation. The average non-performing loan ratio is 1.361%, with a 0.336 standard deviation, reflecting a comparatively low industry level.

Indicating stable asset quality in the sampled banks, with an average capital adequacy ratio of 13.70%, with a standard deviation of 1.959, meeting Basel Accord requirements, reflecting strong risk-bearing capacity.

Table 1. Descriptive Statistics

VARIABLES	observed value	average value	(statistics) standard deviation	minimum value	maximum values
ROA	140	0.987	0.198	0.500	1.467
GCL	140	6.121	6.666	0.450	37.09
CAR	140	13.70	1.959	9.900	19.26
LNTA	140	11.10	1.008	8.451	12.89
NPL	140	1.361	0.336	0.650	2.390
LTD	140	80.66	13.28	49.50	111.2

4 Empirical Analysis

4.1 Correlation Test

Table 2. Correlation test

variant	ROA	GCL	CAR	LNTA	NPL	LTD
ROA	1					
GCL	0.0450	1				
CAR	0.0720	0.218***	1			

LNTA	0.0920	0.368***	0.628**	1		
			*			
NPL	-0.432***	0.0910	0.0670	0.448	1	

LTD	-0.541***	0.109	0.0940	0.090	0.319**	1
				0	*	

As shown in Table 2, the correlation test results indicate that ROA has a weak correlation with GCL. NPL and LTD have a statistically significant negative correlation with ROA, while other variables exhibit varying degrees of correlation.

4.2 Multicollinearity Test

Table 3. Multiple Covariance Tests

Variable	VIF	1/VIF
LNTA	2.60	0.384736
NPL	1.60	0.625931
GCL	1.19	0.841930
LTD	1.17	0.857960
CAR	1.88	0.532462
Mean VIF	1.69	

Table 3 confirms no multicollinearity, allowing regression analysis.

4.3 F-test and Hausman test

Table 4. F-test

F-statistic test	statistic	P-value
statistical value	16.59	0.0000

Table 5. Hausman test

Hausman test	
Prob > chi2	0.0000

Tables 4 and 5 show F-test and Hausman test P-values of 0, leading to rejection of the null hypothesis in favor of the fixed-effects model.

4.4 Benchmark Regression: Validating the Core Impact of Green Finance on Profitability

Table 6. Benchmark regression results

	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA	(6) ROA
GCL	-0.026*** (0.005)	-0.009* (0.005)	-0.005 (0.005)	-0.009** (0.004)	-0.008* (0.004)	-0.039*** (0.007)
CAR		-0.053*** (0.009)	-0.005 (0.013)	-0.017 (0.011)	-0.015 (0.01)	-0.009 (0.01)
LNTA			-0.301*** (0.057)	-0.176*** (0.051)	-0.114** (0.056)	-0.048 (0.053)
NPL				-0.238*** (.033)	-0.231*** (.032)	-0.24*** (.029)

LTD					-.003**	-.004***
					(0.001)	(0.001)
gcl2						0.001***
						(0)
_cons	1.144***	1.773***	4.428***	3.551***	3.044***	2.491***
	(0.032)	(0.114)	(0.513)	(0.446)	(0.486)	(0.455)
	140	140	140	140	140	140
Observations						
R-squared	0.186	0.354	0.473	0.633	0.65	0.713

Notes: Standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6 presents preliminary regression results for ROA and GCL. The findings demonstrate a statistically significant negative correlation for GCL's coefficient. (coefficient = -0.026, $p < 0.01$). Next, we sequentially added the control variables CAR, LDR, and NPL. The coefficients for GCL and LTD remained negative and significant, indicating that despite the widespread advocacy and promotion of green finance in theory, it has not effectively enhanced bank profitability in practice. Finally, the sixth column introduced the quadratic term gcl2 of GCL into the model. The findings indicated a notably positive coefficient for the quadratic variable. (coefficient = 0.001, $p < 0.01$). Overall, the model's R-squared value increased from 0.186 to 0.713, indicating that the model's explanatory power significantly improved after incorporating control variables. This suggests that, after controlling for other factors, there is indeed a significant non-linear relationship between the scale of green credit and bank profitability, and that other control variables also have varying degrees of influence on profitability. This confirms a U-shaped link between green finance and bank profitability, initially suppressing then boosting earnings. This means that as green finance continues to develop, its inhibitory effect on profitability gradually weakens. Once the scale reaches a certain level, the scale effects and synergistic effects of green finance begin to emerge, leading to an improvement in profitability.

4.5 Empirical Results Analysis

Green finance presents both opportunities and challenges. This study examines its empirical outcomes from two viewpoints:

1. Cost-effectiveness advantage

(1) Negative correlation between initial cost investment and profitability

During the initial stage of green finance business development, due to limited market awareness and acceptance of green finance, and the need for green commercial banks to invest significant funds in green finance product research and development, as well as the recruitment of specialised talent, this increases the bank's operational costs in the short term, thereby exerting a certain negative impact on the bank's profitability [8-9].

(2) Positive correlation between long-term cost savings and profitability

On one side of the coin, the growth of green finance ventures enables commercial banks to tweak their asset portfolios and slash the proportion of non-performing loans.

On the flip side, green finance endeavors tend to have extended capital deployment timelines and steady cash inflows, which can bolster banks' capital deployment effectiveness. In addition, in the process of innovating green finance products and services, commercial banks will place greater emphasis on market-based mechanisms and actively reduce costs, such as applying digital technology to improve business processing efficiency and reduce human and time costs. These sustained cost reductions will steadily improve banks' earnings, reinforcing the rising segment of the U-shaped green finance-profitability link.

2.The Dominance of the Substitution Effect

(1) The Limitations of Traditional Business and the Bottleneck in Profitability

Under the traditional financial business model, the business structure is relatively simple. With intensifying market competition and the advancement of interest rate liberalisation, the interest rate spread for traditional deposit and loan businesses has continued to narrow. Additionally, traditional financial businesses have become overly reliant on high-pollution and high-energy-consuming industries. This has made it difficult for banks to achieve sustained growth in profitability, and in some cases, profitability has even declined.

(2) The Substitution Effect of Green Finance and the Improvement of Profitability

Green finance offers commercial banks new business growth opportunities and has the potential to replace traditional business. Green finance encompasses a wide range of business types, enabling banks to diversify their revenue streams and reduce reliance on traditional deposit and loan business. Additionally, engaging in green finance can enhance a bank's brand image and social reputation, attract more high-quality customers, increase customer loyalty, and thereby strengthen the bank's market competitiveness. In the future, under the global carbon neutrality framework, the green economy will emerge as a high-yielding sunrise industry, driving proactive green credit allocation and exerting a substitution effect on traditional credit business. Therefore, as the substitution effect of green finance business gradually gains the upper hand, banks' profitability will significantly improve with the expansion of green finance business scale, exhibiting an upward trend in a positive U-shaped relationship.

5 Conclusion

To put it simply, Chinese commercial banks experience a U-curve effect when it comes to green finance's influence on their bottom line—initially, profitability takes a hit as sustainable financing gains traction, but over time, the trend reverses and yields positive returns.

However, as green finance continues to mature, the long-term cost advantages, enhanced substitution effects, and sustainable development of green finance operations will gradually exert a positive influence on banks' profitability.

Derived from empirical analysis outcomes, the subsequent specific suggestions are formulated: Initially, the development of strategic strategies and corporate alterations. Commercial banks should incorporate green finance into their long-term strategic planning, increase support for green industries, and comprehensively promote the

transformation of business structures toward sustainability. Second, business innovation and risk management. Different types of banks should adopt distinct green finance policies, actively expand green finance business, and strengthen innovation in green finance products and services. At the same time, commercial banks should improve risk management mechanisms during the development of green finance, accurately identify and control risks associated with green projects, optimise asset structures, and thereby enhance the bank's profitability [10]. Third, cost-benefit balance and collaborative development. Commercial banks should focus on short-term cost control, improve operational efficiency, and balance the initial investment in green finance business with short-term benefits. At the same time, they should strengthen cooperation with multiple institutions, leverage policy support and resource synergy, and achieve the sustainable development and profit growth of green finance business.

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