

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

Yuqi Tian

Department of Business Administration, International College, Krirk University, Bangkok, Thailand

Lamu Zhuoma

School of Economics and Management, Dali University, Dali 671000, China

Xiaowen Xie (Corresponding Author)

School of Economics and Management, Dali University, Dali 671000, China

Email: shawnxie.work@outlook.com**Article History****Received:** 25 September, 2024**Revised:** 3 December, 2024**Accepted:** 8 December, 2024**Published:** 13 December, 2024Copyright © 2024 ARPG &
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Abstract

With the increasingly serious problem of environmental pollution, the development of economy must adhere to the road of sustainable development of green economy, and commercial banks have played a vital role in promoting economic development. This paper aims to analyze and evaluate the profitability of commercial banks in the context of green finance by analyzing the main business of commercial banks in the field of green finance and effectively assess the potential risks, and then improve the profitability of commercial banks. According to the current situation of commercial banks, some suggestions on how to improve and become a high-quality and sustainable new commercial bank project are provided. In this paper, data from 2010-2022 are selected as samples to analyze the impact of green finance development on bank profitability through Hausman test, the reliability is verified by robustness analysis. The proportion of green credit has a significant negative impact on bank profitability. Listed commercial banks are sacrificing their own profits to promote the development of green finance. Compared with the previous research data, it is more complete and provides strong empirical support for green finance policy making and bank strategic planning. The conclusion of this paper puts forward constructive suggestions for the future development of green finance in commercial banks.

Keywords: Green Finance; Commercial Banks; Profitability; Green Credit; Empirical Analysis.

1. Introduction

With the continuous development of the "extensive" economy, the growth of the population and the consumption of non-renewable energy, environmental problems are becoming more and more serious. Due to the continuous development of high-carbon economy, it is bound to be accompanied by serious problems of high emissions and high pollution, which will cause the contradiction between economic development and the natural environment to continue to strengthen. In this case, we must maintain a stable national economic development, environmental protection, so now the society pays more attention to environmental protection. Green finance refers to the financial services provided for project investment and financing, project operation and risk management in the fields of environmental protection, energy conservation, clean energy, green transportation and green building. This concept has gradually become the trend of economic development in today's world.

In order to reasonably consider potential environmental factors in financial investment and conduct financial investment behavior, environmental factors should be integrated into decision-making, and the existing resource allocation should be guided to green economy with a purpose in business activities. Compared with the traditional financial industry, green finance pays more attention to the effective use and integration of resource allocation within a reasonable range, and guides the common development of financial activities and environmental protection (Xie, 2023), so as to promote the sustainable development of social economy. China proposed to vigorously develop green finance in 2021, and has initially established corresponding economic and political policies during the development in recent years, and proposed a series of measures to stimulate commercial banks to further develop green finance (Wang, 2022). In recent years, commercial banks have been constantly responding to policies in their development. Green finance can not only help banks to meet new challenges, but also help banks to have outstanding performance in professional competence and market competitiveness (Ding, 2023).

With the proposal of the "double carbon goal" of reaching the peak of carbon and carbon neutrality and the continuous development of the economic transition to low-carbon, green finance has gradually entered the public's vision, and many projects including green credit have developed rapidly, and have become an important part of the business of commercial banks. Banks can provide preferential interest rate loans to green enterprises through financial credit, which is equivalent to the funds that green finance can contain enterprises with high pollution and high emissions. In order to obtain the same preferential interest rate, these enterprises will turn to green finance and

start industrial transformation. In this case, the pressure of commercial banks has increased significantly, and more enterprises have carried out corporate transformation in the context of economic development trend, shifting from various industries to green enterprises (Chen *et al.*, 2021). In order to achieve this goal, a large amount of capital is needed, which leads to the increasing competitive pressure of commercial banks. At present, with the continuous deepening of sustainable development strategy, vigorously developing green finance has become the main direction of the future development of commercial banks. Under this circumstance, commercial banks are also gradually carrying out various contents related to green finance (Shu and Yang, 2015). Under the guidance of the policy, commercial banks are also making in-depth development in the field of green finance, and major commercial banks have released their own strategic methods and implementation standards. Of course, while supporting projects with environmental benefits, profit-oriented commercial banks still need to strive to improve their profitability in the overall environment.

This paper aims to analyze and evaluate the profitability of commercial banks under the background of green finance by analyzing the main businesses of commercial banks in the field of green finance, and the relationship between various green finance projects set up by commercial banks and the competitiveness of commercial banks in the market under the background of green finance. Analyze the non-performing loan ratio represented by credit risk control, the provision coverage ratio to assess the bank's asset quality guarantee ability, the capital adequacy ratio reflecting the bank's risk tolerance, the total return on assets of green finance business, the bank's net interest rate on sales in green finance, non-interest income, and the balance of green loans disclosed in the annual report, etc. This paper analyzes the profit data of commercial banks from green finance, aiming to effectively assess potential risks and further improve the profitability of commercial banks. In view of the current situation of commercial banks, some suggestions are provided on how to improve and become a high-quality and sustainable new commercial bank project.

At present, due to the slow start of China's commercial banks compared with some countries, coupled with the long-standing habit of "extensive" economic growth, although the development of commercial banks has gradually entered the right track in recent years, there are still many problems (Li, 2011). However, the academic community now generally divides green finance into two perspectives: how can various transaction activities and policies in the context of environmentally sustainable development enable financial institutions to guide enterprises to transform and how can financial enterprises innovate in the context of sustainable development? (Liu G. and Wang, 2023). From the perspective of green finance profitability of commercial banks, this study analyzes the profitability of various data, from which we can draw a conclusion on whether the implementation of green finance policy can improve the profitability of commercial banks.

Based on the significance of green finance in social responsibility and as a new form, the attention of the society is gradually increasing, which is of great significance for how to improve the profit competitive advantage of commercial banks in the post-epidemic era at this stage. At present, green finance projects of commercial banks are attracting widespread attention. In this environment, can commercial banks with the purpose of making profits gain benefits? Should commercial banks gain benefits under the premise of strengthening environmental protection, or should commercial banks promote the development of green finance at the expense of their own interests? In 2013, the China Banking Regulatory Commission issued the Notice on Submitting Statistical Forms of Green Credit, after which major banks began to disclose data on energy conservation and emission reduction, green finance, green credit balance, etc., which has greatly promoted the development of green finance in China. Secondly, the social significance of the development of green finance is very important, which can promote enterprises to save energy and reduce emissions, and assume their own responsibility for environmental protection. Based on the panel data of several commercial banks, this paper studies how Chinese commercial banks should better carry out green finance projects in the future based on the current transformation situation of commercial banks, which is of great significance for improving their profitability and business performance.

2. Literature Review

At present, many scholars have done a lot of research on the impact of green finance on the competitiveness and profitability of commercial banks, and scholars at home and abroad have different understandings of this research.

On the one hand, Based on the data of 18 listed commercial banks in China from 2012 to 2020 and the data of 18 commercial banks in China as samples, Fang and Wei (2022) concluded that the implementation of green finance has a significant positive impact on the profitability of commercial banks, and green finance has a significant positive promotion effect on joint-stock banks. Zhou *et al.* (2022), believe that the three dimensions of green financing have significant contributions and prominent roles for each sub-dimension of corporate social responsibility. Wang *et al.* (2021), adopted the differencing method and argued that the implementation of green credit policies would improve the comprehensive competitiveness of commercial banks. Zhang *et al.* (2021), believe that green credit delivery still has a significant positive impact on the improvement of the financial performance of state-owned banks, while it has a significant negative impact on joint-stock banks, and the impact on urban commercial banks is not obvious. (Zhang and Zhang, 2019) took the data from 2008 to 2017 as samples and established a path model to find that green credit business has a certain negative impact on the performance of commercial banks, but the green reputation generated by green credit behavior can effectively improve its performance. Chen and Hu (2022), also believe that green credit has negative policy effects on state-owned banks and city commercial banks, but has no significant policy effects on joint-stock commercial banks. After quantitative analysis, (Gao, 2021), believes that green credit generally has a positive effect on improving the profitability of

commercial banks, but it is not significant. Wan *et al.* (2023), argue that the promotion of fintech to green credit is more obvious in banks with higher profitability or located in eastern China. Lian *et al.* (2022), believe that green credit improves the financial performance of commercial banks, and this improvement mainly comes from the positive impact of green credit on the return on assets of banks.

On the other hand, Liu X. (2020) selected the panel data of 20 listed commercial banks in China from 2013 to 2018 for empirical analysis and argued that for national joint-stock commercial banks, green finance would restrain their profitability to a certain extent due to their cost disadvantage. Gao (2021), based on the panel data from 2008-2017, conclude that green credit will weaken the profitability of small and medium-sized commercial banks. Cai and Ning (2023), believe that green credit can improve the financial performance of commercial banks. There is an inverted U-shaped nonlinear relationship between green credit and business performance of commercial banks. Zhang and Wang (2023), believe that green credit of large-scale banks can have a negative impact on profitability by inhibiting financial innovation ability and increasing risk bearing level through two independent intermediary channels, while green credit of small-scale banks can have a positive impact on profitability by improving financial innovation level. Song *et al.* (2019), believe that the project financing ratio of international banks under the Equator principle has a positive impact on bank profitability, while the green credit ratio of Chinese commercial banks has a negative correlation with its profitability. Zhou *et al.* (2022), argue that the implementation of China's green credit policy reduces the credit risk of major state-owned banks, but increases the credit risk of urban and regional commercial banks. Yin *et al.* (2021), argued that green loans improved the profitability of non-state-owned banks and reduced their risks, but state-owned banks provided green credit at the expense of their profitability.

Through the review of relevant literature, we can see that scholars have different ideas and conclusions on the impact of green finance on the profitability and competitiveness of commercial banks. Some believe that green finance has a positive impact, which can promote the performance of commercial banks and economic development, while others believe that it has a negative impact, and the development of green finance will continuously reduce the profits of banks. The reasons for this lie in the following aspects: First, based on the difference of years, the data within each period of the research data will be updated to improve the data. Compared with 2021, the issuance scale of green financial securities of commercial banks is about three times that of the previous year, which shows that the update of data is very important for the research. Since China started green finance relatively late compared to other countries, there are not many available data, so the difference in years and data is likely to lead to different conclusions. Second, it does not fully consider the bias of each commercial bank, the difference between the green finance organization system and the green finance brand. Third, due to a late start, a mature and effective green financial system has not yet been established. Using the latest data, this paper can reflect the situation of green finance in commercial banks in recent years.

3. Research Methodology

3.1. Methodology

This paper has an in-depth understanding of the background, causes and development process of green finance as well as the green finance models and product projects of various commercial banks. At the same time, it has consulted relevant literature, further sorted out the literature on the basis of understanding the background and principle of green finance, and summarized the ways in which green finance can affect various indicators of commercial banks. And then the research finds out which indicators and projects will have a positive or negative impact on the profitability of commercial banks. The explained variables, explanatory variables and control variables are determined. In this paper, the company's profitability is taken as the explained variable, and the net profit rate on sales, gross profit rate on sales, net profit rate on assets, return on equity and other indicators are selected to construct the relative index value of commercial banks' profitability. At present, green credit is the most representative in the development of green finance in China, and the implementation data of green credit of various banks can be directly shown from the balance of green credit in the self-disclosed annual reports of various banks. At the same time, data such as the non-performing loan ratio represented by credit risk control, the provision coverage ratio to assess the bank's asset quality guarantee ability, the capital adequacy ratio reflecting the bank's risk tolerance, the total return on assets of green finance business, the bank's net interest rate on sales in green finance, non-interest income, and the balance of green loans disclosed in the annual report are used as the main control variables. Finally, all the data are brought into the model for analysis, and the relationship between green credit and other data on the profitability of commercial banks is obtained. Scholars have been debating whether green finance will affect the profitability of commercial banks. This paper, based on existing cases, studies the data of various projects among banks developing green finance in the Chinese market, such as the total return on assets of green finance business, the net interest rate of sales of banks in green finance, and non-interest income, so as to combine theory with practice. Conduct multi-faceted research, and analyze the above specific content, and draw a conclusion on the impact of the profit level through the data. This paper analyzes various factors and influencing mechanisms that affect the profitability of commercial banks, including the political situation and economic environment at the macro level, and the attitude and implementation projects of various banks towards green finance, the competitiveness of enterprises and the results of current projects at the micro level.

3.2. Model & Regression Equation Specification

In our analysis of the impact of green finance on the profitability of commercial banks, we employ a panel data random effects model. The selection of this model is predicated on several considerations relevant to our dataset,

which comprises multi-period data for various banks. Below, we detail the rationale behind opting for the random effects model over alternatives such as the fixed effects model:

The random effects model is particularly suited for data that spans across multiple periods and entities. It efficiently captures variability across both dimensions, making it ideal for our dataset that includes observations over several years for different banks. This model assumes that the individual-specific effects (such as specific strategies and cultures of banks) are uncorrelated with the explanatory variables. Given our dataset, this assumption is reasonable as bank-specific unobserved factors might be orthogonal to other covariates in the study. Random effects models generally offer higher statistical efficiency compared to fixed effects models when there is no perfect multicollinearity among the variables. This efficiency is crucial in econometric analysis, where the precision of estimates significantly impacts the robustness of the conclusions. Unlike fixed effects models, random effects models allow for the estimation of impacts from time-invariant variables, such as long-term strategic orientations of banks, which are of interest in our study.

These advantages render the random effects model a fitting choice for examining the relationships in question, thereby providing robust and insightful results about the effects of green finance on bank profitability.

To estimate the impact of the proportion of green credit (GLR) on the profitability of commercial banks (measured by Return on Assets, ROA), we specify the following regression model:

$$ROA_{it} = \beta_0 + \beta_1 GLR_{it} + \sum \beta_n X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Where: ROA_{it} is the return on assets for bank i on time t . GLR_{it} represents the green loan ratio, defined as the balance of green loans to total loans. X_{it} represents a set of control variables which includes loan growth rate (LGR), deposit growth rate (DGR), non-performing loan ratio (NLR), provision coverage ratio (PCR) and inflation rate for bank i on time t .

This model allows us to directly assess the influence of the green loan ratio on commercial bank profitability while controlling for macroeconomic factors and bank-specific random variations. Employing this methodology facilitates a nuanced understanding of how green finance influences the profitability of commercial banks in a dynamic economic landscape.

3.3. Data Acquisition

The empirical data mainly come from the public information data of listed commercial banks and the CSMAR database of Guotai 'an. By the end of 2022, the number of listed banks in China has grown to 59, including 6 large state-owned banks, 10 joint-stock banks, 30 urban commercial banks and 13 rural commercial banks. The assets of 59 listed banks exceeded 265 trillion Yuan, accounting for about 84% of the total assets of China's commercial banks. Since the official release of the Green Credit Statistical System in 2012, the statistics of green credit data of various banks have been gradually standardized. Due to the continuous update of data, the data of 13 years from 2010 to 2022 are selected in this paper, and the listed corporate banks selected include five large state-owned banks, including joint-stock banks such as Pudong Development, China Merchants and CITIC Bank. And Beijing, Nanjing and other regional banks, including a total of 30 listed commercial banks.

3.4. Variable Selection

The profitability of commercial banks has a wide range, and the overall profitability level needs to be determined based on the synthesis of many different indicators. Therefore, this paper selects return on assets (ROA) as the explained variable, which can reflect the profitability of commercial banks to a certain extent. The higher the ROA, the stronger the profitability of the enterprise. Since a comprehensive data index is needed to analyze the profitability level, this paper selects ROA as the explained variable (Chen and Zhao, 2012).

The core explanatory variable of this paper is green credit. Due to the rapid start and development of green credit, green credit has been relatively mature compared with other green finance projects. In addition, since green credit can reflect the real situation of green loans in various banks, this paper selects the balance of green credit self-disclosed in the financial reports of various commercial banks. In order to make the data more objective, the green loan ratio (GLR) of green credit is selected as the core explanatory variable (Wang and Wang, 2024).

In the empirical analysis of the impact of green finance on the profitability of commercial banks, it is crucial to control for factors that might confound the primary relationship of interest. We include four control variables in our regression model: loan growth rate (LGR), deposit growth rate (DGR), non-performing loan ratio (NLR), and provision coverage ratio (PCR). Each of these variables is selected based on its theoretical relevance and empirical importance in the banking profitability literature.

Loan growth rate is defined as the percentage change in the total loan portfolio of a bank between two consecutive periods. Loan growth is a significant indicator of a bank's business expansion and risk appetite. Higher loan growth might indicate more aggressive lending practices, which can lead to higher profitability but also greater risk exposure, potentially affecting the bank's financial health (Zhou *et al.*, 2022).

Deposit growth rate measures the annual percentage increase in a bank's total deposits. Deposits are a primary source of funds for banks, and their growth reflects the bank's capacity to attract and retain customers' savings. Stable deposit growth is often associated with increased lending capacity and financial stability, influencing the bank's profitability (Dietrich and Wanzenried, 2011).

The non-performing loan ratio is the proportion of the bank's loan portfolio that has been deemed non-performing (i.e., in default or close to default). The NLR is a critical measure of credit risk. High values of NLR indicate poor credit quality and can lead to higher provisioning costs, directly affecting profitability. Controlling for

NLR allows us to isolate the effect of green finance from the influence of the bank's credit risk management (Louzis *et al.*, 2012).

The provision coverage ratio indicates the extent to which a bank has set aside capital to cover potential loan losses. PCR is an indicator of a bank's prudential stance towards potential loan losses. A higher PCR suggests a conservative approach to risk management, potentially buffering the bank's profitability against the shock of loan defaults. Including PCR helps in assessing whether green finance impacts profitability through changes in risk perception and management (Laeven and Majnoni, 2003).

GDP Deflator is an indicator reflecting the overall inflation rate of the whole country. It shows the rate of price changes of the whole economy and can measure the impact of price changes of various commodities on the overall price level. This index includes the most comprehensive range and can more accurately reflect the trend of general price level (Liang, 2004). The inflation rate is equal to $(\text{GDP deflator} - 1) \times 100\%$. In order to prevent the macro impact, this paper chooses gross domestic product (GDP) and Inflation rate as the control variables.

Table-1. Definition and measurement of variables

Variables	Variable name	Variable meaning	Calculation method
Explained variable	Return on assets (ROA)	Return on total assets	Net profit \div total assets $\times 100\%$
Core Explanatory variable	Green loan ratio (GLR)	Proportion of green credit	Green loan balance \div total bank loan $\times 100\%$
Control variables	Loan growth rate (LGR)	The percentage change in the total loan portfolio of a bank between two consecutive periods.	$(\text{Total Loans}_{it} - \text{Total Loans}_{it-1}) / \text{Total Loans}_{it-1} \times 100\%$
	Deposit growth rate (DGR)	The annual percentage increase in a bank's total deposits.	$(\text{Deposits}_{it} - \text{Total Deposits}_{it-1}) / \text{Deposits}_{it-1} \times 100\%$
	Non-performing loan ratio (NLR)	The proportion of the bank's loan portfolio that has been deemed non-performing.	Non-Performing Loans _{it} / Total Loans _{it} $\times 100\%$
	Provision coverage ratio (PCR)	The extent to which a bank has set aside capital to cover potential loan losses.	Loan Loss Provisions _{it} / Non-Performing Loans _{it} $\times 100\%$
	Inflation rate	The extent to which the price level has risen over a period of time Index	$(\text{GDP deflator} - 1) \times 100\%$

4. Data analysis and Robustness Testing

This study selected the financial data of 30 Chinese commercial banks during 2010-2022 as analysis samples, aiming to explore the impact of green finance development on bank profitability. In order to accurately estimate the role of green finance on bank profitability, this paper first uses Hausman test to determine whether to adopt fixed effect model or random effect model for panel data analysis. The results of Hausman test support the use of random effects model, indicating that there is no systematic correlation between bank-specific unobserved effects and explanatory variables in the context of this study, making the random effects model a more appropriate choice.

Then, this paper constructs two models to analyze the impact of green finance development on bank profitability. Model 1 only considers the explanatory variable of the proportion of green credit, while Model 2 adds a series of control variables including loan growth rate, deposit growth rate, non-performing loan ratio, provision coverage rate and inflation rate on this basis to control other factors that may affect bank profitability.

Table-2. The impact of green finance development on bank profitability

Variable	Model 1	Model 2
Proportion of green credit	-3.61*** (0.5602)	-2.24** (0.5536)
Loan growth rate		2.04** (0.1478)
Deposit growth rate		-0.30 (0.1400)
Non-performing loan ratio		-8.99*** (0.04561)
Provision coverage ratio		-5.56*** (0.0001)
Inflation rate		-3.83*** (0.0034)
_cons	25.80*** (0.0400)	18.84*** (0.0880)

Note: **, *** indicates the significant level at 5% and 1% level, respectively. The numbers in brackets represent standard errors.

The results of regression analysis show that in model 1, the ratio of green credit to bank profitability (represented by ROA) has a very significant negative impact, with a coefficient of -3.61, which is significant at the significance level of 1%. This indicates that as the proportion of green credit of banks increases, their profitability tends to decline. The results of Model 2 further confirm this finding. Even after controlling variables such as loan growth rate, deposit growth rate, non-performing loan ratio, provision coverage rate and inflation rate are added, the negative impact of green credit ratio on bank profitability is still significant, with a coefficient of -2.24 and significant at the significance level of 5%. It is worth noting that in Model 2, except for the non-significant coefficient of deposit growth rate, the coefficients of other control variables are significant, indicating that these factors also affect the profitability of banks to varying degrees. In particular, the negative significance coefficient of non-performing loan ratio and provision coverage ratio emphasizes the importance of bank asset quality. The negative significance coefficient of inflation rate may reflect the influence of macroeconomic environment on bank profitability. By comparing model 1 and model 2, it can be clearly seen that although the coefficient of the proportion of green credit decreases after the introduction of control variables, its negative impact on bank profitability remains significant. This finding suggests that the development of green finance, while positive for promoting sustainable development and environmental protection in the long run, may have a negative impact on the profitability of commercial banks in the short term. Therefore, for banks, while promoting green finance business, they need to balance its impact on spot profitability, optimize credit structure, improve risk management ability and other measures to achieve sustainable development of green finance and healthy growth of banking business.

Based on the analysis of the financial data of 30 Chinese commercial banks from 2010 to 2022, this paper further adopts robustness test measures to verify the reliability of the analysis of the impact of green finance development on bank profitability. Robustness test is mainly carried out by changing the model setting and adjusting the sample range to ensure the robustness and reliability of the research results.

As part of the robustness test, this paper first uses a fixed effects Model (Model 3) to re-analyze the data. The fixed effects model can control those individual specific effects that do not change over time, so it focuses on analyzing the influence of time series changes on bank profitability. In Model 3, the coefficient of the proportion of green credit is -1.4278, which is significant at the significance level of 5%. Compared with the random effects Model (Model 2), although the coefficient changes, the symbols remain the same, indicating that the negative impact of green credit ratio on bank profitability is still robust under different model Settings. In addition, the significance of the loan growth rate and the non-performing loan ratio has also been maintained, further emphasizing the importance of these variables in the analysis of bank profitability.

In Model 4, this paper carries out tail-shortening treatment on all variables and selects samples from different periods for testing to consider the influence of external factors such as the global financial storm and the stock market crash in China. In particular, due to the impact of the US subprime mortgage crisis in 2008 and the stock market crash in China in 2015, samples before 2015 were excluded in this paper to exclude the potential impact of these abnormal events on the analysis results. In the adjusted Model (Model 4), the coefficient of green credit ratio is -0.6075, which is significant at the level of 10%. Although the significance level has decreased, it still confirms the negative impact of green credit ratio on bank profitability. In addition, loan growth remained significant, while the coefficients for deposit growth and provision coverage became insignificant, possibly due to a decline in the explanatory power of the sample adjusted model for these variables.

Table-3. The robustness tests

Variable	Model 3	Model 4
Proportion of green credit	-1.4278** (0.5680)	-0.6075* (0.3598)
Loan growth rate	0.3418** (0.1468)	0.4148** (0.1736)9
Deposit growth rate	-0.0538 (0.1326)	0.1952 (0.2462)
Non-performing loan ratio	-0.4083*** (0.0445)	-0.2082 (0.1364)
Provision coverage ratio	-0.0006 (0.0001)	0.0000 (0.0004)
Inflation rate	-0.0139 (0.0033)	-0.0017 (0.0043)
_cons	1.6674*** (0.0842)	1.0814*** (0.3012)

Note: *, **, *** indicates the significant level at 10%, 5% and 1% level, respectively. The numbers in brackets represent standard errors.

The results of these robustness tests show that while changes in model setting and sample size may have an impact on the size and significance level of the coefficients, the core conclusion that the ratio of green credit has a negative effect on bank profitability remains robust. This finding highlights the need for banks to carefully consider the potential impact on profitability and adopt strategies to balance the development of green finance with the maintenance of profitability in the process of promoting green finance. Through these robustness tests, the analysis

results of this paper show high reliability and reliability, and provide strong empirical support for green finance policy making and bank strategic planning.

5. Conclusion and Suggestion

On the basis of summarizing the relationship between green finance and the profitability of commercial banks in China, this paper uses the panel data of 30 listed commercial banks from 2010 to 2022 to investigate the impact of green finance on the profitability of commercial banks through empirical analysis.

Overall, the proportion of green finance has a significant negative impact on bank profitability, and this conclusion is still valid after passing the robustness test. It can be proved that listed commercial banks are sacrificing their own profits to promote the development of green finance.

Empirical results show that: from the overall view of the current panel data, the development of green finance will weaken the profitability of commercial banks. The reason may be that there is no mature green finance policy in China at present, and the current development of green finance is not complete and the development time is short. There are great differences in the time when each bank started green finance. Some banks have only begun to develop green finance in recent years, and the atmosphere of green finance is weak in the short term. In addition to some state-owned banks, most commercial banks also have small business in green finance, resulting in obvious deficiencies.

Theoretically, green finance should promote the profit growth of commercial banks, but according to the conclusion of empirical analysis, the development of green finance has a negative impact on commercial banks.

From the perspective of the government, the state's current guidance on green finance is insufficient. For commercial banks aiming at profit, profit and social effect form opposite sides. At the same time, some environmental protection departments have not properly implemented green policies, affecting the development of green projects. From the bank side, the development of green finance is not only a task assigned by the state, but also some banks regard this task as a project to attract customers in the social responsibility report. We can see from the data that the time when commercial banks started green finance is very different. Some banks have started green finance projects before 2010, while some banks only started green finance projects in 2019. Although there may be differences in the listing time of enterprises, it can still be seen that banks have different views on green finance projects.

This paper believes that the government can gradually introduce more rigorous policies to provide a favorable environment for the green development of commercial banks, and at the same time develop professionals to guide enterprises how to obtain green loans and banks how to make profits on green finance projects. Banks should also carry out risk control at the same time, integrate the information of all parties and establish a new information system (Zhou, 2014), and establish professional green finance consulting services, so that enterprises of all parties can understand the nature of green finance to the greatest extent, and speed up the cooperation with the development of projects.

This paper also has some shortcomings, for instance, the analysis object of this paper is the data of a total of 30 listed commercial banks from 2010 to 2022, and there is still a lack of data maturity. There are many factors that can affect the profitability of commercial banks. This paper only chooses RGDP and CPI as control variables, which is difficult to reflect all factors. The data comes from the social responsibility report disclosed by the enterprise and the CSMAR database of Guotai 'an, but some data are still missing due to the enterprise's failure to disclose and other reasons, which makes the data display incomplete.

As for future research direction, we believes that different green finance projects can be studied and innovated, such as the evaluation of carbon credit and other aspects can be included in the overall evaluation of green loans. Study how to balance the relationship between the risks brought by green finance and the profitability of banks effectively; Examine how big data and high-tech technologies can be used to track and regulate green finance projects; Study how to promote financial institutions to participate in green finance projects and how to promote customers to choose green financial products.

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