The Impact of Green Credit on the Profitability of Commercial Banks in a Low-Carbon Context

Yue Li *

School of Business, Xi'an University of Finance and Economics, Xi'an, 710100, China

* Corresponding Author Email: 100325@yzpc.edu.cn

Abstract. This paper delves into the concept of green credit and its theoretical underpinnings, contending that it exerts a discernible influence on the profitability of commercial banks. Through empirical investigation employing an individual fixed effect model, it seeks to ascertain the precise impact of green credit on the profitability of such banks. Drawing on panel data encompassing 16 commercial banks in China spanning the period from 2011 to 2020, this study undertakes a thorough analysis to gauge the extent to which green credit affects bank profitability. The findings of this analysis not only contribute to a deeper understanding of the relationship between green credit and bank profitability but also inform potential strategies for enhancing the financial performance of commercial banks in the context of environmental responsibility. By synthesizing these insights with a comprehensive analysis of the prevailing circumstances, the paper concludes by offering recommendations aimed at bolstering the profitability of commercial banks, thereby aligning their operations more closely with sustainable principles and environmental objectives.

Keywords: Low Carbon; Green Credit; Commercial Bank; Profitability.

1. Introduction

The country is proposing to reach a peak in CO2 emissions by 2030, while achieving carbon neutrality by 2060.To make double carbon a reality, it must be done in many ways, and financing is an important factor in connecting these aspects [1]. Through the optimal distribution of capital, to curb capital flows to industries such as "two high and one leftover", while guiding capital flows to energy conservation and emission reduction, green environmental protection and other sustainable development fields, thus realizing the regulation of capital flows, through such a way that not only reduces carbon emissions in the output field, but also can improve the carbon adsorption and sequestration capacity in the recycling field, achieve the balance between carbon emissions and carbon sequestration, and promote the smooth realization of the "double carbon" target. Green credit can adjust the flow of funds and achieve the strategic goal of optimizing the allocation of funds [2]. Green credit can more efficiently guide capital flows to green low-carbon industries, not only providing financial support for these industries, but also implementing a “dual-carbon” policy [3]. At present, China's green credit development has just started, and the financial institutions that carry out green credit business are mostly commercial banks. Since the release of the "China Central Committee's Central Committee on the Complete and Accurate Implementation of the New Development Concept for Carbon Dap Peak Carbon Neutrality Neutrality in 2021", the carbon DPC Neutrality and related policies have been intensively introduced in China's green credit has basically built up and down linkages, block combination, and grasp the co-management working pattern, carbon DFC carbon neutrality and "1+N" policy system.

Green credit development has a role to promote the improvement of profit scale of commercial banks to optimize internal resource allocation. Zhang and Zhou research found that if commercial banks raise green credit ratios, they can not only increase their profit scale, but also improve and optimize their internal resource allocation, thereby improving their operating efficiency. The authors analyze the efficiency of commercial banks by establishing a data envelope model with non-desired output (SBM-DDF) [4].

The development of green credit can help financial institutions improve the operational efficiency of commercial banks while reducing negative economic, environmental and social impacts. Akomea

et al. by studying the role of sustainability and green credit in the Indian commercial banking system, pointed out that green credit in India can improve the profitability of commercial banks by improving reputation and accelerating operational efficiency, and as IT and physical infrastructure expansion, commercial banks accelerate the process of sustainable development and environmental protection has also been implemented [5].

Green credit will significantly promote the sustainable development of commercial banks, and remain valid after controlling the relevant variables and robust testing. In the long term, it can greatly improve the robustness of commercial banks and improve their profits. Ding et al. has further tested that the impact of green credit on the high-quality sustainability of banks will be affected by green environmental regulation and monetary policy. Green environmental regulation and loose monetary policy will promote green credit development, which in turn has a positive impact on the high-quality and sustainable development of banks. The results of the heterogeneous test show that green credit has a significant difference in the impact of different sizes and regions of banks, and the positive impact of green credit on the high-quality and sustainable development of small banks and regional banks is more significant [6].

At present, the research on the impact of green credit on the profitability of commercial banks is mainly based on the relevant theory, and the study from the current situation of China, paste and green credit development status, for the follow-up study provides reference value. This paper selects a number of relevant profitability indicators to conduct a more comprehensive analysis of the profitability of commercial banks, and more accurately and effectively analyze the impact of green credit on the profitability of commercial banks. Although such studies have been conducted before, most studies use the data time interval for empirical analysis in about 5 years, and this article has chosen from 2011 to 2020, a total of 10 years, and sufficient historical data can ensure that the analysis results are more accurate and effective. In summary, the paper on the impact of green credit on commercial bank profitability analysis has some reference significance for the future scholar's research on this issue.

2. Data Selection

2.1. Hypotheses Development and Variable Construction

In theory, banks actively develop green credit business in line with the relevant national policies, can improve the comprehensive competitiveness of banks through certain reputation effect, and thus improve the comprehensive profitability of banks. However, on the other hand, due to the domestic green credit is still in the infancy, the current mechanism of green credit issuance of commercial banks is not perfect, the relevant professional talent is relatively lacking, and green projects are relatively short, the project cycle is longer, the demand for upfront funds is larger, the pace of return is relatively slow, too much development of green credit business may put pressure on banks to finance flows, and thus weaken banks' profitability. Green credit plays a role in promoting or weakening bank profitability depending on the combined impact of both. Combined with the above analysis, the following two assumptions are reasonably put forward.

Hypothesis 1: Green credit plays a suppressive effect on commercial banks' profitability

Hypothesis 2: Green credit plays a role in the profitability of commercial banks

According to relevant research and commercial banks at home and abroad, this article selects the total asset return as the interpreted variable, the green credit balance as the explanation variable, non-performing loan rate, capital adequacy rate, allocation coverage and asset liability ratio as a control variable, as shown in Table 1.

Table 1. Variable Construction.

Variables	Symbol	Formula of indicators
Return of assets	ROA	Net profit/average asset total
Green credit ratio	GLR	Green loan balance/total bank loan
Non-performing loan rates	NPLR	Total non-performing loans/total bank loans
Capital adequacy rate	CAR	Capital/weighted venture capital
Allocation coverage	PC	Lending loss reserve balance/non-performing loan balance
Asset and liability ratio	DAR	Total liabilities/total assets

2.2. Descriptive Statistics

The empirical data of this paper mainly comes from various data released by various commercial banks each year, as well as the databases such as CSMAR. This article selected 16 listed commercial banks from 2011 to 2020, totaling 160 sample data. From Table 2, the average value of the 16 commercial banks selected is about 1.011%, which shows that China's commercial banks have a considerable profit level.

Table 2. Descriptive Statistics.

	ROA	GLR	NPLR	CAR	PC	DAR
Average	1.011	4.739	1.243	12.893	249.468	93.336
Standard deviation	0.223	5.046	0.423	1.731	100.523	1.29
Minimum value	0.511	0.348	0.22	8.84	132.44	91.059
Median	1.001	3.617	1.235	12.635	223.57	93.385
Maximum value	1.475	29.374	2.39	17.52	778.12	97.827

3. Empirical Analysis

3.1. Theoretical Models

Panel data model can be divided into mixed regression model, fixed effect regression model and random effect regression model. To ensure the accuracy and efficiency of empirical analysis, the appropriate model is needed to regression the sample data. The choice of panel data regression models involves two tests, Hausman and F. Hausman testing can determine whether using a fixed effect regression model or a random effect regression model, and whether a fixed effect model is used or a mixed regression model is performed. This paper selected data from 16 banks for 10 years as sample data, individual data is significantly more than time nodes, reasonably assuming that the fixed effect regression model built in this article should be the individual fixed effect regression model.

$$\mathrm{ROA}_{it} = \alpha_i + \beta_1 \mathrm{GLR}_{it} + \beta_2 \mathrm{NPLR}_{it} + \beta_3 \mathrm{CAR}_{it} + \beta_4 \mathrm{PC}_{it} + \beta_5 \mathrm{DAR}_{it} + \varepsilon_{it} \quad (1)$$

The variable indicators i and t represent the data of the first individual in the t-year, are the cross-cutting, are the regression coefficient of the variable, and are a random error item.

3.2. Testing and Correlation

3.2.1. Correlation Matrix

Observing the correlation test results in Table 3, it was found that there is no coefficient greater than 0.5 between the variables, which indicates that the variables are independent of each other, and it can be concluded that there are basically no multiple colinear problems between the variables in this paper. The positive and negative direction of the observation factor can be found that there is a positive correlation between the return on assets of commercial banks and their capital adequacy, allocation coverage and green credit ratios, and they have mutually reinforced roles. There is a negative correlation between the rate of return on assets and the ratio of non-performing loans and assets and liabilities, and there is a mutually dissuaded effect between each other.

Table 3. Correlation Matrix

	ROA	GLR	NPLR	CAR	PC	DAR
ROA	1					
GLR	0.0359	1				
NPLR	-0.2609	0.2129	1			
CAR	0.1625	0.1473	0.279	1		
PC	0.1001	-0.1245	-0.4562	-0.0973	1	
DAR	-0.1256	-0.1351	-0.3794	-0.4483	0.4908	1

3.2.2. F-Test and Huasman-Test

For F-testing of data, the original assumption of F-inspection is that the original model is regressing using mixed utility. The p-value in the test results is 0, indicating that the model is remarkable at 1% of the significance level, that is, the sample data passed the F test, refused to accept the original assumption of the original model using mixed utility for regression, should be regression using the fixed effect model, sample data has an individual effect (see Table 4).

Table 4. Results of F-Test.

Effect Test	Statistic	d.f.	Prob.
Cross-section F	578.652	-15,139	0
Cross-section Chi-square	10404.2463	15	0

Hausman tests are used to determine whether the use of fixed-effect model regression or random-effect model regression, and the original assumption indicates that the random effect model should be established, the results are shown in Table 5.

Table 5. Results of Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f..	Prob.
Cross-section random	357.8369	5	0.0013

As available from the above table, the model's Hausman test p value is smaller, rejects the original assumption, so the fixed effect model is regression. In summary, the assumption of the individual fixed effect regression model is established in the previous section

3.2.3. Regression Results and Analysis

Table 6. Results of Fixed Effect Regression.

	Coefficient	Std. err.	t value	P value
GLR	-0.00729	0.00375	-1.94	0.024
NPLR	-0.29306	0.04104	-7.14	0
CAR	-0.02812	0.01244	-2.26	0.025
PC	0.00029	0.00017	-1.75	0.042
DAR	0.00323	0.01838	0.18	0.861
C	1.54427	1.86313	4.93	0
n=160; F-test that all ui=0: F(15,139)=33.17; Prob>F=0.0000				

Table 6 indicates that the p-value of the GLR indicator is 0.024, and the proportion of green credit of commercial banks has a negative impact on its return on assets, that is, the development of commercial banks' green credit business will have a negative impact on its profitability, assuming 1 is established.

The non-performing loan rate is negative, i.e. the relative increase in bank non-performing assets can put banks in crisis. High non-performing loan rates may result in banks requiring more capital to cover risks, thereby increasing the cost of banks. Furthermore, high non-performing loan rates may also result in banks requiring more funding to cope with potential losses, which will reduce bank profits. If banks are unable to effectively handle non-performing loans, the rate of non-performing

loans may continue to rise, with further negative implications for the bank's financial position and reputation. Thus, lower non-performing loan rates are beneficial to boost banks' profitability.

The negative capital adequacy factor, the higher the capital adequacy rate, the less flexibility of banks to operate, as banks need to maintain a certain capital adequacy rate to meet regulatory requirements, meaning banks cannot be fully used to scale up operations or increase revenue. High capital adequacy rates also lead to banks being at a disadvantage in competition, as other banks with lower capital adequacy may use more capital to scale up their businesses or increase their earnings, thereby generating higher profits.

The higher the allocation coverage factor, the higher the allocation coverage, indicates that banks have a more adequate understanding of the risk of non-performing loans and more accurate forecasts of possible losses. Banks are more cautious in lending and management, reducing risk exposure, thereby reducing non-performing loan rates and increasing overall asset yields. Second, higher reserve coverage can improve bank reputation and enhance market trust in banks. In this way, banks can get more deposit and loan operations, expand their operations and further increase the yield of total assets. Finally, higher allocation coverage also enhances banks' financial robustness and risk resistance. If there are adverse situations such as increased non-performing loans, banks can better cope with risks, avoid getting into trouble, maintain healthy operations and development. In this way, banks can achieve more robust and sustainable development in the long-term business process, thereby increasing the yield of total assets. High allocation coverage means banks are better able to cope with risks, with stronger financial robustness and risk resistance, which has a positive impact on the bank's overall asset yield.

The balance-and-liability ratio is positive, and debt capital often has lower costs, especially in the period of lower interest rates, combined with China's macroeconomic analysis in recent years, since 2010, China's market interest rate level is gradually declining, commercial banks can use low interest debt capital to invest and expand, further obtain higher profits. On the other hand, high asset-liability rates may also push commercial banks to be more active in their business, as banks need to maintain sufficient levels of profitability to pay for their debts. In this case, high asset-liability rates can drive commercial banks to seek more opportunities for earnings growth, thereby increasing the overall asset yield.

3.2.4. Robust Test

In addition to reflecting the return on assets, commercial banks can also be used to represent the rate of return on net assets, which this article replaces the interpreted variable with net assets yield. Conduct robust testing. The comparative test results in Table 7 found that after the replacement variable, the estimated coefficient of the green credit policy effect variable is still negative, the absolute value and the baseline model estimate results are very close, and the estimated coefficient of the control variable is similar. Therefore, the findings of this paper are relatively sound.

Table 7. Results of Robust Testing

	Coefficient	Std. err.	t value	P value
GLR	-0.16956	0.05537	-3.06	0.003
NPLR	-4.67006	0.60291	-7.75	0
CAR	-0.34459	0.18195	-1.89	0.06
PC	-0.00354	0.00244	-1.45	0.149
DAR	2.30949	0.26857	8.6	0
C	-187.9862	27.21634	-6.91	0
n=160; F-test that all u_i=0: F(15, 139) = 35.03; Prob > F = 0.0000				

4. Recommendations

4.1. Continuously Improving the Incentive Mechanism for Green Credit

Because green low-carbon projects have long cycles, low-income and high cost characteristics compared to traditional projects, some commercial banks are more difficult to make when carrying out green credit operations. For profitability reasons, they tend to lend in high-return industries and have less autonomy and enthusiasm for the green credit business. To this end, the relevant departments in China need to continue to improve the performance assessment and fiscal discount system, differentiated deposit reserve rate and related green credit incentives [7]. First, the government should establish a system of energy conservation and emission reduction guarantee fund. By allocating financial funds, it provides certain guarantees for commercial banks' green credit funds, sharing some of the risks of commercial banks in green credit, alleviating the pressure they may face; and the government should step up the fiscal discount on green credit. In order to better promote the development of green credit business, commercial banks should introduce interest rate preferences for projects consistent with green credit [8]. At the same time, the government should introduce interest in commercial banks for the profit of commercial banks, spread subsidies. To avoid the consideration of commercial banks in pursuing their interests, the green credit business is reduced. The state should give tax relief or financial subsidies for the “three high” projects exiting commercial banks to reduce partial losses and reduce the concerns of commercial banks to carry out green credit operations. Finally, the People's Bank, including local branches, shall agree on appropriate green credit rates, and give commercial banks a certain range of interest rate floating, so that commercial banks can flexibly carry out green credit operations [9]. At the same time, the banking industry needs to establish reasonable and orderly green credit performance incentives, and a monitoring system for the review and evaluation of green credit operations carried out by commercial banks. To carry out certain rewards for banks actively carrying out green credit business, and impose certain penalties on banks that have violated lending practices, thus playing a certain role in the development of green credit business of commercial banks [10].

4.2. Increasing Input in Green Credit Product System Innovation

Banks should increase the innovation of green credit products and enrich the channels of funding supply. For enterprise users, when applying for environmental protection projects or buying energy-saving and environmental protection equipment, banks can provide preferential loans to enterprises, for large equipment can take financial leasing. For individual users, rich credit products for individuals in the green consumer field [11]. With the continuous implementation of the new development concept into all aspects of social life, the number and scale of individual green consumption will continue to increase. Commercial banks can launch more diverse green credit products to meet personality and broad green consumer needs. Segment market positioning for customers' purchase needs, public transportation needs and shopping needs [12]. When consumers make green consumption, they give preferential policies such as incentives and subsidies, which further promote the green consumption needs of customers. In this way, not only enhances the differentiation of commercial banks competitiveness, so that the commercial bank intermediate business development is greener, but also expands the wider green derivatives. With the continuous enrichment of green credit products, the recognition of commercial banks and the reputation of commercial banks have also improved, and also promoted the development of the whole society's green finance [13].

4.3. Strengthen Professional Talent Training

In order to reduce green credit costs, improve green credit revenue, and thus improve profitability, commercial banks need to pay attention to the rational training of green credit professionals. Because whether it is the process of evaluating, approving, managing, or innovating green credit products, professionals play a crucial role [14]. As an emerging economy business, green credit lacks talent in

the development process. Therefore, commercial banks should pay attention to training talents and conduct targeted training for business personnel so that they can better identify environmental risks. In addition, commercial banks can use university resources to offer courses related to green credit, thus providing excellent talent to commercial banks to help them successfully carry out green credit business [15].

5. Conclusion

This paper selected 16 banks with relatively complete disclosure data from 2011 to 2020 as a research sample, and built the model for regression. Through empirical analysis, it is found that the commercial bank green credit business has a negative impact on the asset return of commercial banks, i.e. profitability, because the green industry project lending funds to lower interest levels squeezed the original high interest income, and at the same time to carry out green credit business requirements for eligibility audit, risk assessment requirements are more stringent, time and manpower cost consumption increase, bank profitability generally decreased. At present, green credit in China is still in the early stage of development, some commercial banks launched green credit business is still not standardized, and because China's green credit development is still in its infancy, enjoy the scale of the dividend cannot be realized in a short time, some banks to carry out green credit business more is passive, and not to develop green credit, accelerate the development of China's green economy development process has played a substantial contribution. At the same time, the green credit business compressed the original "two high and one left" industries loan profits. As a result, its green credit business has reduced its profitability.

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