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ANALYSIS OF THE IMPACT OF GREEN CREDIT ON THE PROFITABILITY OF CHINESE COMMERCIAL BANKS

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ABSTRACT

Since opening to the outside world, China's economy has developed rapidly, but the contradiction between economic development mode and ecological environment has become increasingly prominent. Therefore, the government has decided to make green development and ecological civilization construction a major task of the 13th five-year plan. And because the bankindustry is the backbone of economic development, its profitability has also attracted the attention of the government. The government decided to develop green credit as a major measure to protect China's ecological environment and improve the profitability of Banks. Therefore, this paper focuses on the analysis of whether green credit will have a positive impact on the profitability of Chinese commercial Banks.

Firstly, this paper introduces the main achievements of green credit research. Secondly, it expounds the influencing factors of bank profitability. Finally, basing on the data of 10 Banks from 2009 to 2017, I establish the fixed effect regression model to obtain the empirical analysis results.The result of this paper shows that there is a short-term inverse relationship between green credit and bank profitability, which is inconsistent with the theoretical results. Therefore, how to solve such a short-term dilemma, give play to the positive role of green credit, and thus develop into long-term interests is the most important task at present. This paper draws conclusions through empirical results and puts forward corresponding policy suggestions, hoping to help China promote the development of green credit.

KEYWORDS: *Green credit, Bank earnings, The panel model*

I . INTRODUCTION

Recently years, Chinese economy has developed rapidly, the profitability of Banks has increased significantly, while environmental pollution has been deteriorating. According to the world conservation union, China has 366 cities with an average annual PM2.5 concentration of 50.2 micrograms per cubic meter. As a result, all cities do not meet the world health organization's air quality guidelines. As we all know, environmental pollution not only does harm to human body, but also restricts economic development. Therefore, the government attaches great importance to environmental problems. Although laws had been introduced to promote the implementation of environmental protection measures, they have played only a limited role. In addition, its disadvantages are increasingly exposed, such as high input cost and low benefit. Therefore, the responsibility to improve the environment cannot be borne by the government alone, but also needs enterprises and the public. Moreover, as the main force of economic development, banks not only provide financial services for the public and enterprises, but also mobilize social capital resources, so they have more profound significance in assuming social responsibilities. Chinese banks make profits mainly by deposit and loan spreads, so credit plays a very important role in promoting the development of Banks. So in this context, green credit was born.

Green credit refers to that financial institutions such as commercial Banks take environmental protection into consideration in their daily business activities and credit decisions, conducting environmental assessment before providing financial support to enterprises, and implying different credit decisions according to the assessment results. It was first proposed in 2007. Compared with foreign green finance theories, the development of green finance theory is relatively short, so Chinese research on this aspect is still a new field.This paper chooses to analize the relationship between green credit and bank profitability. On the one hand, it can make up for the insufficient research on green credit in China; on the other hand, it can put forward feasible suggestions for Chinese banks to implement green credit. In addition, banks can not only gain long-term benefits from green credit, but also prevent risks. All in all, it is very valuable to analyze the relationship between green credit and bank profitability.

II. LITERATURE REVIEW

2.1 domestic and foreign theories on green credit

"Green credit" is a common term in China, but it is called "sustainable finance" around the world. The world commission on environment and development first defined sustainable development in the 1980s. After that, countries began to study the relationship between economic development and environmental protection. At the end of the 20th century, the United States proposed comprehensive environmental response, compensation and liability act, which for the first time took environmental factors into account in the service activities of the financial industry. Subsequently, scholars began to study the field of sustainable finance. But at first, foreign scholars mainly analyzed the meaning of sustainable finance and related influencing factors. Comprehensive correlation theory, the sustainable financial means: Marcel Jeucken (2001) is the first to correlate the financial industry and the sustainable development, Sonia and Rodney (2002) said the sustainable finance is designed to measure the environmental quality and risk specific financial instruments, Paul and Chrislopher (2006) said sustainable finance refers to the bank to investment projects and examination mechanism of enterprise environmental information into the lending, and in order to decide whether to lend. Referring to relevant international literatures, it can be concluded that green credit refers to the way that enterprises are encouraged to save energy and reduce emissions, and environmental factors are incorporated into banks' loan decisions, so as to promote industrial upgrading and the transformation of economic development mode.

With the emergence of the "equator principle", most banks take green credit as the basic principle to undertake environmental and social responsibilities. Conley and Wiliams (2011) explained why banks should join the equator principle and how the equator principle would affect banks. By quantitative methods, Macve and Dam (2007) concluded that banks adopt the equator principle have higher costs, but stronger sense of social responsibility and less risk of loans than other banks. In short, the equator principles benefits the environments,and it's also a way for banks to manage their own risks.

Chinese green credit development is relatively late. In 2007, the China environmental protection administration, the people's bank of China and the China banking regulatory commission jointly formulated the opinions on implementing environmental protection policies and regulations and preventing credit risks. The regulation requires banks to add environmental compliance to their lending requirements. Since then, Chinese experts have been delving into the subject of green credit. Heavens, A.(2004) proposed that it is indispensable both in terms of reducing ecological risks and increasing profit and income, as well as in terms of integration and coordinated development. For banks to follow the green credit policies set by the government, they must also recognize the benefits to their own profits. Kin Keung Lai(2011) proposed that the promotion of green credit is the general direction of sound operation of banks.In addition, Michael NYONG (2010) analyzed the data of 13 banks from 2008 to 2012 and believed that there was a significant negative correlation between green credit and banks' profitability in the short term. Michael NyarkoBaasi (2018) analyzed data from 10 banks from 2006 to 2014 and reached the same conclusion. So how to solve such a short-term dilemma will become an urgent problem. In the long run, the development of green credit will increase the total amount of bank loans and increase bank profits. In a short period of time, the development of green credit will lead to the negative attitude of economic entities due to the unsound legal system and other related reasons.

2.2 The analysis of bank profit factors in China and other countries

Hester (1969) collected the data of 300 banks in the United States for four years, taking the pre-tax, after-tax net profit and operating income as variables, and using the regression model to analyze the positive and negative relationship between assets and liabilities on the profitability of banks. Although there will be some differences in the economic development between sample regions, Pasiouras et al. (2006) believe that the total asset size has a significant positive relationship with the profitability of banks. In addition, Smirlock (1985) proved that market share also had a positive effect on banks' profitability and competitiveness. Wang, Y. T. , (2014) said that improving bank asset size and market concentration is an effective way to get more profits.Nsiah Richard and Ohene Joseph (2014) analyzed the data of 15 Banks for five years and believed that the ratio of fixed assets had a positive effect on their profitability, while the provision for loan impairment would have a negative effect. Zhang Miao (2002) said that there is an inseparable relationship between banks' profitability and loan quality, that is, the lower the non-performing loan ratio is, the better the bank's loan quality is, which is conducive to promoting banks to obtain more profits. In addition, bank capital is also an important factor to affect profitability. The higher the core capital adequacy ratio is, the weaker the profitability will be. But this is contrary to the original intention of regulators to force banks to have sufficient capital to resist risks. Guo Wenwei and Chen Yanling (2011) said that the main reason is that banks withdraw too much capital to meet regulatory standards, resulting in insufficient utilization of capital.

III. THE EMPIRICAL ANALYSIS

3.1 Variable selection and data sources

The research object of this paper is the impact of green credit on bank profitability. So in order to show the profitability of banks, this paper decided to use ROA as the explained variable,while using indicators of banks' green credit, assets and loans are the explanatory variables. In addition, considering that the research object of this paper is ten Chinese banks, and the economic status of each bank has a relatively obvious gap, so in order to ensure the accuracy and credibility of the empirical results, external economic factors of the bank were also taken into account. This paper selects 10 banks as samples, including Industrial and Commercial Bank of China, China Merchants Bank, China Construction Bank, China Citic Bank, Bank of China, China Everbright Bank, Agricultural Bank of China, Industrial Bank, Bank of Communications, and Shanghai Pudong Development bank. Since the concept of green credit was proposed relatively late, in order to facilitate data collection and sorting, this paper selected sample data of 10 banks from 2009 to 2017 for empirical analysis, and used Excel and Eview9.0 software for data sorting. The index system constructed in this paper is as follows:

ROA: ROA indicates the profitability of unit assets, which is a better indicator of bank profitability than other indicators. The higher the indicator, the more profits the bank gets.

An indicator of green credit conditions—GLR: This index reflects the total amount of bank loans to green enterprises credit support; China proposed that vigorously developing green credit plays a great role in improving the profitability of banks, which is of great significance in tapping the development potential of economy and accelerating the transformation and upgrading of industrial structure. Therefore, it can be concluded that the higher the indicator is, the stronger the profitability of the bank is.

Green credit covers a wide range of aspects, and in the annual corporate social responsibility reports of various banks, some of them directly report the green credit amoun, while others only report the investment amount of energy conservation and environmental protection projects. Therefore, in order to avoid the data discrepancy affecting the accuracy of the empirical results, the ten commercial banks selected in this paper directly give the amount of green credit.

Indicators of loan quality—loan provision ratio (LPR) and bad loans (BL): LPR is the ratio of provisions to total loans; Nagata, S., and Suda, T. (1995). proposed that when LPR was fixed, the provision would increase with the increase of the total loan amount, indicating a significant counter-cyclical phenomenon. When the economy is booming, the amount of bad loans goes down, but provisions go up, mainly to minimize losses from the recession. However, it should be noted that excessive withdrawal of loan provisions will easily lead to a large number of funds occupied, and the capital utilization rate of banks will decline, thus negatively affecting the profitability of banks.

BL is the ratio of the amount of non-performing loans to the total amount of loans; Mishra, N.,etc(2003)found that economic development has an important impact on the non-performing loan ratio of banks, which in turn affects the stability and security of the banking industry. Therefore, the paper use non-performing loan ratio to reflect the operation and safety of banks.

Indicator of capital position—core capital adequacy ratio (CCAR): This index reflects the strength of banks against risk. Pérezllarena, F. J.etc (1997) believed that improving the core capital adequacy ratio will enhance the profitability of bank assets and ensure the safety of bank operation. However, Bretagnol, F.,etc(2010) proposed that in the case of weak profitability of Chinese commercial banks, in order to meet the regulatory standard of capital adequacy ratio,excessive improvement of capital adequacy ratio would be improved,this also affect the expansion of banking business and thus weaken their profitability. So banks will have to keep their capital within reasonable limits, which will encourage them to make more profits.

An indicator of a bank's size: the logarithm of total assets (LNTA): A bank's size and competitive strength are reflected in its total assets. Mehrpoo, M., & Staszewski, R. B. (2013) believed that bank performance would be limited by its size. In order to facilitate the study, this paper chooses to use the logarithm of total assets.

Indicators related to external economic environment: market share (MS): Since it is difficult to accurately calculate the total assets of the banking industry, this paper uses the proportion of each bank's assets in the sum of the total assets of the ten banks to explain its status in the industry.

To sum up, the variable indexes selected in this paper are as follows:

Table 3-1 definitions and symbols of variables

variable	defination	symbol
Profit levels	Average of after-tax profit/total assets at the beginning and at the end	ROA
Green credit ratio	Green credit balance/total lending	GLR
Balance sheets	The impairment provision/total amount lent	LPR
Capital position	Equity capital/(asset *risk factor)	CCAR
Bank size	Logarithm of total assets	LNTA
Loan quality	Non-performing loan ratio	BL
Market share	Individual bank assets/total assets of each bank	MS

Table 3-2 descriptive statistical analysis of variables

variable	Descriptive statistics			
	The maximum	The minimum	The average	standard deviation
ROA（%）	1.80000	0.7500	1.1727	0.1772
GLR（%）	22.8545	0.9371	5.3575	3.8878
LPR（%）	4.53000	1.1200	2.4863	0.7139
CCAR（%）	13.1300	6.6300	9.5230	1.2823
LNTA（? 元）	12.3109	9.3907	10.9439	0.8266
MS（%）	23.0000	3.0000	10.0000	7.1688
BL（%）	2.91000	0.3800	1.0910	0.4518

It can be seen from table 3-2 that, first of all, GLR of most banks is relatively low, and there are obvious differences among banks. Some banks green credit ratio can reach the highest 22.8545%, the lowest only 0.9371%. Secondly, CCAR is significantly higher than China's capital supervision requirements of 5%, which means that China's banks are strong in debt repayment and risk prevention. At the same time, it also shows that China's banks have the problems of insufficient use of capital and limited profits. While the loan provision ratio of banks is obviously different, the highest can reach 4.35%, and the lowest is less than 2.5% of the regulatory standard. This means that Chinese banks still have some credit risks. At last, it can be seen from the data statistics that the non-performing loan ratio of China's banks is relatively low, all lower than 5% of the regulatory standard, which reflects the good operation mode of deposit and loan spread of China's banks.

3.2 Model selection and construction

It can be seen from the theory that there is a certain relationship between banks' profitability and green credit ratio, average return on total assets, asset size, core capital adequacy ratio, loan provision ratio, non-performing loan ratio and industry status. An appropriate model must be chosen beforeempirical analysis; If the selected model is wrong, the accuracy of the conclusion will be insufficient. Both F and the haltzman test are used to determine how to choose the regression model. The F test is to determine which is better, the fixed-effect regression model or the mixed regression model. The haltzman test is used to distinguish the fixed effect regression model from the random effect regression model.

3.2.2 Test of empirical model

1. F test

First, the paper established the mixed regression model for analysis, and obtained the sum of squared residuals and SSEr. Secondly, the fixed effect regression model was established to obtain the squared residues and SSEu. Finally, the formula of F statistic was substituted. If the F statistic value follows the distribution of degrees of freedom (n-1, nt-n-k), the null hypothesis is accepted and the mixed regression model is selected; otherwise, the fixed-effect regression model is selected.

As shown in Figure 1 below, mixed regression analysis is adopted by Eviews9.0 software.

Figure 1: results of mixed regression model

R-squared	0.566693	Mean dependent var	0.011727
Adjusted R-squared	0.475470	S.D. dependent var	0.001772
S.E. of regression	0.001284	Akaike info criterion	-10.31213
Sum squared resid	9.39E-05	Schwarz criterion	-9.894555
Log likelihood	373.9246	Hannan-Quinn criter.	-10.14627
F-statistic	6.212198	Durbin-Watson stat	1.482457
Prob(F-statistic)	0.000001		

As shown in the figure above, both R^2 and modified R^2 are around 0.50, and the overall fitting degree is general, indicating that the influence of explanatory variables on explained variables is not significant enough. According to this table, SSEr= 9.39E-0.5, or 25.02467.

As shown in figure 2 below, the fixed effect regression analysis was carried out through the Eviews9.0 software.

Figure 2: results of fixed-effect regression model

R-squared	0.928761	Mean dependent var	0.021741
Adjusted R-squared	0.908972	S.D. dependent var	0.013805
S.E. of regression	0.001094	Sum squared resid	6.47E-05
F-statistic	46.93393	Durbin-Watson stat	1.841116
Prob(F-statistic)	0.000000		

As can be seen from the figure above, the values of R^2 and modified R^2 are both higher than 0.9, and the associated probability is 0, indicating that this model is more suitable. In addition, SSEu= 6.47E-0.5, or 17.08728, can be obtained from the figure.

In conclusion, it is more appropriate to establish a fixed effect regression model. Therefore, in order to make a more accurate judgment, the squared sum of residues, SSEr and SSEu, were substituted into the F formula.

$$F = \frac{(SSEr - SSEu)/(N-1)}{SSEu/(NT-N-1)} = \frac{(25.02467-17.08728)-(10-1)}{17.08728/(70-10-1)} = 3.0452$$

Because F=3.0452>F0.05(9,59)=2.043, the original hypothesis was overturned and a fixed effect regression model was established.

2.Hausmann test

In this paper, suitable models are selected according to the results of the haltzman test. As shown in figure 3, the hausmann test was carried out through Eviews9.0 software.

Figure3: Hausmann Test

Correlated Random Effects - Hausman Test
Pool: POOL
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	21.289179	6	0.0016

As can be seen from the above table, W=21.289179> ¡ 20.05(6)=12.59, and the P value is 0.0016, meeting the 1% level. Therefore, the null hypothesis is rejected and the fixed effect regression model is established.

Based on the results of F and haltzman test, the fixed effect regression model was finally selected in this paper. Therefore, this paper establishes a specific empirical model for each explanatory variable and the explained variable, as shown below:

$$ROA\ (it) = \alpha i + \beta 1 GLRit + \beta 2 LPRit + \beta 3 CCARit + \beta 4 LNTAit + \beta 5 MSit + \beta 6 BLit + uit$$

In the above formula, ROA_{it} represents the average total return on assets of bank I in year t; ~ is the regression constant term; it denotes the coefficient of the explanatory variable; uit means the random error term.

3.Unit root test

Before the regression analysis, the unit root test must be used to determine whether the variable is stable or not. The unit root test method of panel data mainly includes the same root test and different root test. Therefore, we selected a unit root test for each variable, mainly LLC test and fisher-pp test, and the results are shown in the following table:

Table 3-3 unit root test

Variables	LLC Test		Fisher-PP Test	
	Result	Probability	Result	Probability
ROA	-49.4798	0.0000	38.2861	0.0082
LPR	-9.9409	0.0000	38.3975	0.0079
CCAR	-28.0668	0.0000	99.5549	0.0000
INTA	-6.7995	0.0000	40.0938	0.0049
MS	-7.4193	0.0000	30.7960	0.0006
GLR	-6.8801	0.0000	34.0675	0.0257
BL	-14.4970	0.0000	51.2807	0.0001

As can be seen from the above table, the test results of these variables are all stable, so regression analysis can be carried out directly. The regression results obtained are shown in table 3-4:

Table 3-4 results of fixed-effect regression model

Variables	Coefficient	standard deviation	T value	P value
C	-0.012702	0.004307	-2.948725	0.0047
GLR	-0.003623	0.004007	-0.904136	0.0502
LPR	-0.075475	0.031267	-2.43895	0.0192
CCAR	-0.015139	0.016235	-0.932480	0.3552
INTA	0.002590	0.000517	5.014181	0.0000
MS	0.018136	0.015619	1.161135	0.2507
BL	-0.203276	0.021069	-9.648287	0.0000

According to the regression results, the t statistics of INTA and BL were significant at the level of 1%. It indicates that the larger the bank's asset size is, the lower the non-performing loan ratio is, and the stronger the bank's profitability will be. The t statistic value of LPR is significant at the level of 5%, but this index has a negative relationship with the profitability of Banks. The main reason is that Banks withdraw too much loan provision, which will affect the business expansion of Banks and thus affect the profits of Banks. Meanwhile, the T value of GLR is -0.003623, and the probability of making mistakes is less than 10%. This shows that GLR has a significant negative effect on Banks' profitability. In addition, MS has a positive effect on the profitability of Banks, while CCAR has an opposite effect. The main reason is that Banks withdraw too much tier 1 capital, which leads to a large amount of idle capital, thus increasing the management cost of banks and ultimately leading to the decline of Banks' profit margin.

Therefore, the equation of the fixed effect regression model can be written:

$$ROA(it) = -0.012702 - 0.003623 GLRit - 0.075475 LPRit - 0.015139 CCARit + 0.002590 LNTAit + 0.018136 MSit - 0.203276 BLit + uit$$

In the above formula, ROA_{it} represents the average total return on assets of bank I in year t; ~ is the regression constant term; it denotes the coefficient of the explanatory variable; Uit means the random error term.

3.3 Empirical analysis

According to the regression results, the coefficient of GLR is -0.003623, indicating that for every unit increase in GLR, ROA will decrease by 0.003623. The T value of GLR is -0.904136, and the P value is 0.0502, meeting the significance level of 10%, indicating that there is a significant inverse relationship between the ratio of green credit and banks' profitability. But such a conclusion does not well prove that the development of green credit will improve the profitability of banks. The main reasons are cost and risk.

From the perspective of cost, Hu Rongcai and Zhang Wenqiong (2016) proposed that in the case of fixed core net assets, banks would increase business and management expenses in order to carry out green credit, thus reducing the profitability of banks. This means that Banks' green credit operations will reduce profits. From the perspective of risk, Zheng Shuizhu and Wei Yunyun (2016) proposed that banks' green credit business would incur losses due to environmental risks, credit risks, operational risks, legal risks and market risks, thus reducing profits. From the perspective of ecological risk, the state has issued a series of relevant laws to regulate enterprises' bad behavior of environmental pollution, which will affect the survival and development of enterprises. As a result, lenders face the risk that their loans may not be repaid. From the perspective of credit risk, most green credit projects are launched with environmental protection as the main consideration factor, and these projects have large capital input, long cycle and low profit return rate, so they will not bring optimistic profits to the bank in the short term, but will increase the bank's business costs. From the perspective of operational risk, due to the lack of effective communication mechanism between Banks and environmental protection supervision agencies, it is difficult to obtain comprehensive and real enterprise information, so it is easy to make wrong lending decisions. All these lead to the risk that the bank's loan will be difficult to recover. From the perspective of legal risks, as China's relevant laws and regulations on green credit are not perfect enough, Banks will be unable to protect their own rights and interests due to the lack of laws when dealing with credit conflicts, thus affecting their profits. From the perspective of market risks, bank assets will suffer from the reduction of earnings due to interest rate fluctuations, the increase of borrowing costs and the impact of profits.

IV. CONCLUSIONS AND POLICY RECOMMENDATIONS

4.1 Conclusions

This paper selected the data of the development of green credit of 10 banks in China from 2009 to 2015 as samples to study the impact of green credit on bank profitability. The result shows that, in the early days of development, green credit did not help banks make more money, on the contrary, it will increase the investment cost of the bank and reduce the income. This conclusion is inconsistent with the theory, mainly because the domestic green credit started late, so the time span selected in this paper is limited, which will lead to the development of green credit in the short term will not get significant benefits. According to the theoretical and empirical results, only by improving the legal system of green credit, improving the information exchange and sharing mechanism, and building the encouragement and restraint system, can the development of green credit become long-term interests.

It can be seen from the above that the development of green credit is not an easy task, but a gradual process. Although there will be many obstacles and difficulties in the development of green credit, we must not shrink from it. We must adhere to the green development of the financial sector and take a long-term view of the current situation. However, with the continuous improvement of China's financial legal system and the gradual construction of incentive and control mechanisms, the positive effect of green credit on banks' profitability will be more significant.

In a word, banks should actively promote green credit business, because it is not only an effective way for banks to fulfill their social responsibilities, but also an effective way for banks to enhance their profitability. Therefore, banks should actively improve the current implementation of green credit is not in place, so as to achieve its sustainable development model with economic, social and ecological environment.

4.2 policy Suggestions

1. Improving the legal system

The sound law is the premise of the development of green credit, so the legislature must take measures to improve the relevant mechanism. This not only reduces the friction in each department's work processing, but also can effectively complete the work. In addition, improving the law will not only protect the rights and interests of economic subjects, but also increase their authority.

2. Improving the information exchange and sharing mechanism

Firstly, information from the central bank, the ministry of environmental protection, the ministry of supervision and management and other institutions will be sorted out, and then a message sharing platform will be established to provide judgment criteria for Banks to issue green credit. Secondly, the ministry of environmental protection must release information on polluting enterprises in a timely manner to help Banks avoid credit risks. Finally, bank branches in different regions and at different levels must communicate with each other more in issuing green credit so as to improve the lending mechanism.

3. Building encouragement and restriction system

The first is to tax the profits Banks make from green credit. Secondly, environmental factors must be included in the evaluation of government performance. Only in this way can local governments be motivated to take the initiative to pay attention to the environment. Finally, we must strictly deal with the violations of polluting enterprises. Only in this way can we reduce the environmental damage of enterprises and strengthen their awareness of environmental protection.

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