

Can Green Credit Reduce Industry Loan Concentration?

-- Empirical Evidence from Listed Commercial Banks

Zheng Ma

School of Finance, Anhui University of Finance and Economics, Bengbu 233000, China

Abstract

Based on the annual data of listed commercial banks from 2008 to 2022, this paper empirically studies the effect of green credit on the concentration of loans in the commercial banking industry by constructing a panel data model. The research shows that commercial banks' development of green credit business can significantly reduce the concentration of their industry loans. Further research shows that: for large-scale state-owned banks, green credit is more effective in reducing the concentration of their industry loans. Based on the empirical results, policy recommendations are put forward from the three levels of government, bank and technology.

Keywords

Green Finance; Commercial Banks; Loan Concentration.

1. Introduction

Although the traditional development model promotes rapid economic growth, it also causes problems such as excessive consumption of natural resources and deterioration of the ecological environment, which restricts the sustainable development of the economy. In this context, the development of green finance has become the only way to achieve high-quality economic and financial development in China. Since the State Environmental Administration, the People's Bank of China and the former China Banking Regulatory Commission jointly issued the "Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risks" in 2007, relevant green financial policies have emerged. After more than ten years of development, as of the end of 2021, the balance of green loans in domestic and foreign currencies in China is 15.9 trillion yuan, ranking first in the world in terms of issuance scale.

As the most important policy tool of the green financial policy, green credit restricts credit support to traditional industries such as "high energy consumption, high energy consumption and excess energy consumption" through bank credit channels, so as to promote the flow of financial resources to an environment-friendly market and realize the harmonious coexistence between man and nature. However, from a traditional perspective, green financing projects generally have problems such as large capital demand, long investment cycle, relatively low returns, and high risks, and often lack commercial sustainability. Data show that although the scale of green credit in China has increased year by year in the past ten years, the proportion of green credit has risen very slowly. For a long time, the proportion has fluctuated within 9%-10%, lacking growth momentum. Due to the lack of enthusiasm of banks to carry out green credit business, a large amount of credit resources are still accumulated in traditional industries, and the industry concentration of credit funds has buried hidden risks for banks.

In order to further stimulate the endogenous power of commercial banks, it is not enough to rely solely on policy-driven development. Green credit also needs to have a positive impact on the development of banks themselves. Then, can commercial banks develop green credit to alleviate the concentration of industrial loans in the banking industry? How to deal with the

relationship between the two has certain theoretical and practical significance for promoting Sustainable Development and Preventing Financial Risks.

2. Literature Review and Research Hypothesis

With the continuous development of my country's green credit, the academic circles focus on the measurement and effect evaluation of green credit. Regarding the influencing factors of commercial bank loan concentration: some scholars have studied the three major commercial banks in the country. The dynamic dependence of credit supply from 1987 to 1996 explained the loan following phenomenon from the perspective of behavioral finance (Rotheli , 2001) [10] ; pointed out that in order to maximize profits and prevent risks, commercial banks' credit resources and loan authority were highly concentrated in a single customer, industry and region, resulting in an imbalance in loan quality structure (Wang Fuhua and Jiang Shanshan, 2012) [11 [11] . The bank's high-quality operating capabilities and efficient management capabilities can improve the credit distribution of commercial banks (Chen Yibing and Nie Guangli, 2014) [12].

To sum up, relevant research in the academic circle has achieved fruitful theoretical and empirical results, but there is little research on the relationship between green credit and the concentration of loans in the banking industry, from the perspective of the impact of green credit on banks and the factors that affect loan concentration. In view of this, this paper argues that green credit restricts the provision of loan support to the "two high and one surplus" industries, so that loans are transferred from traditional industries to emerging industries, avoiding the homogenization of bank assets to a certain extent, and theoretically alleviating the concentration of industry loans; the development of green credit business stems from corporate social responsibility. From the perspective of the nature of property rights, state-owned banks undertake more social responsibilities than joint-stock banks. In addition, due to differences in political levels, from the perspective of political performance, state-owned banks are more committed to green credit and more stringent in the approval of loans in traditional industries such as "two highs and one surplus"; compared with small-scale banks, large-scale banks play a decisive role in the economy and society.

The signal of "too big to fail" means stronger green credit issuance. Based on theoretical analysis, this paper puts forward the following research hypotheses:

Research Hypothesis 1 : Commercial banks' development of green credit business can significantly reduce the concentration of their industry loans.

Research hypothesis 2 : Compared with joint-stock banks, green credit has a better effect on reducing the industry loan concentration of state-owned banks.

Research hypothesis 3 : Compared with smaller commercial banks, green credit has a better effect on reducing the concentration of loans in the larger commercial banking industry.

3. Variable Selection and Data Sources

3.1. Variable Selection

(1) The explained variable: The explained variable in this paper is the industry loan concentration (HHI) of commercial banks, calculated by the Herfindahl - Hirschman index, which is widely used to evaluate the market share distribution of enterprises in a certain industry or market.

$$HHI_{i,t} = \sum_{x=1}^n \left(\frac{loan_{i,t,x}}{loan_{i,t}} \right)^2$$

Among them, it represents the number of loans issued by bank i to industry x in year t , and represents the total amount of loans issued by bank i to industry n in year t . By calculating the sum of the squares of the proportion of loans in various industries, the corresponding HHI index is obtained. The higher the HHI value, the more concentrated the commercial bank loans are, and the higher the industry loan concentration is. $loan_{i,t,x} / loan_{i,t}$.

(2) Explanatory variable: The main explanatory variable in this paper is the scale of green credit disclosed by commercial banks (GL), which is used to measure the level of green credit issued by commercial banks.

(3) control variables; referring to the existing research, this paper selects the control variables to cover the bank's micro-level and macro-economic level. Control variables at the micro-bank level include cost-to-income ratio, return on assets, capital adequacy ratio, and liquidity ratio; control variables at the macro-economic level include GDP growth rate and the proportion of new loans. See Table 1 for definitions of relevant variables :

Table 1. Variable Summary Table

name	symbol	Relevant instructions
Industry Loan Concentration	HHI	The higher the HHI, the more intensive the bank loans are invested in the industry
green credit	GL	Bank's current green credit balance
Cost to income ratio	CIR	Operating cost / operating income, used to reflect the bank's operating efficiency
Return on Assets	ROA	Net profit / average total assets to reflect bank profitability
capital adequacy ratio	CAR	Reflects the bank's risk tolerance
liquidity ratio	LR	Current assets / current liabilities, reflecting the liquidity of bank assets
GDP growth rate	GDPGROWTH	reflect macroeconomic growth
Proportion of new loans	LOANGDP	Reflect changes in the financial cycle

3.2. Data Sources and Related Instructions

Considering the availability and representativeness of the data, as well as the implementation nodes of the green finance policy, the sample selects the annual data of 21 major banking institutions (excluding 3 policy banks) identified by the China Banking and Insurance Regulatory Commission (CBIRC) from 2008 to 2022; the green credit balance data comes from the "Corporate Social Responsibility Report" disclosed by each listed commercial bank; the measurement of industry loan concentration HHI and the control variables at the micro level are manually compiled from the annual report data of commercial banks; the macroeconomic level data comes from the wind database. In order to eliminate the outlier disturbance caused by the large difference in the value of the HHI index, this paper performs natural logarithmic processing on the obtained industry loan concentration and green credit balance. The measurement software in this paper is STATA14.0 version. The results of variable descriptive statistics are shown in Table 2:

According to the results of descriptive statistics, the industrial loan concentration of different commercial banks in major banking institutions is quite different, with the minimum value being 1.653 and the maximum value being 39.784. The median value of 7.372 is lower than the average value of 9.123, indicating that among the selected samples, more than half of the commercial banks' industry loan concentration is lower than the average level, and the credit risk is relatively ideal. The statistical results of the control variables also show that different

commercial banks have certain differences in terms of profitability, operating efficiency, and risk tolerance.

Table 2. Statistical results of variable descriptions

variable symbol	average	standard deviation	minimum value	maximum value	median
HHI	9.123	5.759	1.653	39.784	7.372
wxya	2.022	0.632	0.503	3.683	1.998
lnGL	25.632	1.589	20.945	29.012	25.768
CIR	32.481	8.230	21.590	72.681	30.340
ROA	0.986	0.246	0.149	1.475	0.985
CAR	12.679	1.966	8.330	18.020	12.445
LR	48.271	10.935	27.600	75.580	47.620
GDPGROWTH	7.054	2.645	0.760	10.600	7.200
LOANGDP	18.136	4.079	15.000	27.530	16.655

4. Empirical Research

This part studies the effect of green credit on the concentration of commercial bank loans by constructing a panel data model. After testing the robustness of the model, the samples are distinguished according to various standards to study the difference in the impact of green credit on different banks, in order to put forward policy recommendations for the development of green credit business in the banking industry.

4.1. Benchmark Regression Analysis

In order to verify research hypothesis 1, this paper establishes the following unbalanced panel data model based on the data of listed commercial banks from 2008 to 2022 to examine whether green credit can reduce the concentration of industry loans.

$$\ln HHI_{i,t} = \alpha + \beta_1 \ln GL_{i,t} + \beta_2 controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

Model 1 is the intercept item, and the regression coefficient reflects the impact of α β_1 green credit on the concentration of industry loans: if the regression coefficient is greater than zero and significant, it means that green credit will aggravate the concentration of loans in the banking industry; if the regression coefficient is less than zero and significant, it means that green credit will alleviate the concentration of industry loans. The control variables include the individual bank indicators and macroeconomic indicators at the micro level above; it is a random disturbance item; it represents the first commercial bank and represents the year. $controls_{it} \varepsilon_{it} i t$.

According to the regression results in table 3, before the control variables are introduced, the coefficient of the core explanatory variable after the ols regression is negative, indicating that green credit can reduce the concentration of industry loans and pass the test of economic significance. After the BP test and the hausman test were carried out on the model, the fixed effect model was selected for regression analysis. In the regression result (3), the regression coefficient of the core explanatory variable lnGL is significantly negative at the 10% level, indicating that commercial banks' development of green credit business can significantly reduce the concentration of industry loans, and research hypothesis 1 is established. In the regression results of the control variables, the regression coefficients of return on assets ROA and cost-to-income ratio CIR are significantly positive, indicating that commercial banks'

profitability and operating efficiency are positively correlated with industry loan concentration. The reason may be that emerging industries such as energy conservation and environmental protection have a long investment return cycle. The degree is low and the risk tolerance is strong.

Table 3. Benchmark regression results

	(1)	(2)	(3)	(4)
wxya	ols	pols	fe	re
lnGL	-0.0128 (-0.41)	0.107 ** (2.41)	-0.0877 * (-1.79)	-0.0611 (-1.38)
CIR		0.0296 *** (3.52)	0.0244 ** (2.10)	0.0277 *** (2.78)
ROA		-0.327 (-1.11)	0.415 * (1.80)	0.448 ** (2.05)
CAR		-0.0509 (-1.17)	-0.0568 ** (-2.00)	-0.0515 * (-1.87)
LR		-0.0101 * (-1.90)	0.000197 (0.06)	-0.000338 (-0.10)
GDPGROWTH		0.0411 (1.31)	-0.0129 (-0.59)	-0.00780 (-0.38)
LOANGDP		-0.0130 (-0.84)	-0.00929 (-0.91)	-0.00865 (-0.90)
Constant term	2.340 *** (2.94)	-0.179 (-0.18)	4.081 ** (2.49)	3.190 ** (2.21)
N	178	168	168	168
R ²	0.001	0.175	0.409	0.408

Note: *, **, *** mean passing the 10%, 5%, 1% significance test respectively, and the t statistics are in the brackets.

4.2. Robustness Check

(1) Introduce dummy variables: During the sample selection period, the former China Banking Regulatory Commission issued the "Green Credit Guidelines" in February 2012 to promote the development of green credit by banking financial institutions, which put forward various requirements for financial institutions to carry out green credit business. This paper introduces the policy dummy variable *policy* to examine whether green credit can still reduce the concentration of industry loans.

$$\ln HHI_{i,t} = a_0 + a_1 \ln GL_{i,t} + a_2 \text{policy} + a_3 \ln GL_{i,t} * \text{policy} + a_4 \text{controls}_{i,t} + \varepsilon_{i,t} \quad (2)$$

It represents the interaction term between green credit and the "Green Credit Guidelines" policy document, taking the policy before 2012 as 0 , and the policy after 2012 as 1 . The regression results are shown in (1) and (2) in Table 4 . The regression results (1) in table 4 show that after introducing the policy dummy variable policy , the sign and significance of the regression coefficient of the original core explanatory variable lnGL are not changed, indicating that green credit can still reduce industry loan concentration; the interaction coefficient is negative but not significant, indicating that this document has a certain effect on reducing industry loan concentration. $\ln GL_{i,t} * policy$.

Table 4. Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)
wxya	fe	re	fe	re	fe	re
lnGL	-0.103 *	-0.0777			-0.0866 *	-0.0596
	(-1.74)	(-1.42)			(-1.82)	(-1.39)
GLR			-0.0132 *	-0.0127 *		
			(-1.70)	(-1.70)		
policy	0.141	0.0799				
	(0.12)	(0.07)				
lnGL*policy	-0.00359	-0.00187				
	(-0.08)	(-0.04)				
CIR	0.0241 **	0.0267 ***	0.0287 **	0.0293 ***	0.0257 **	0.0289 ***
	(2.05)	(2.58)	(2.60)	(3.03)	(2.25)	(2.98)
ROA	0.392 *	0.427 **	0.525 **	0.510 **	0.423 *	0.465 **
	(1.71)	(1.96)	(2.41)	(2.44)	(1.88)	(2.21)
CAR	-0.0545 *	-0.0507 *	-0.0607 **	-0.0579 **	-0.0537 *	-0.0490 *
	(-1.83)	(-1.75)	(-2.15)	(-2.13)	(-1.93)	(-1.80)
LR	0.000563	0.0000484	0.00101	0.000756		
	(0.16)	(0.01)	(0.29)	(0.22)		
GDPGROWTH	-0.00855	-0.00586	-0.00407	-0.00322	-0.0125	-0.00677
	(-0.35)	(-0.25)	(-0.20)	(-0.16)	(-0.58)	(-0.33)
LOANGDP	-0.00653	-0.00687	-0.00786	-0.00795	-0.00952	-0.00863
	(-0.55)	(-0.59)	(-0.78)	(-0.84)	(-0.94)	(-0.90)
Constant term	4.336 **	3.562 **	1.594 **	1.575 **	3.974 **	3.040 **
	(2.38)	(2.14)	(2.28)	(2.30)	(2.45)	(2.15)
N	168	168	168	168	169	169
R ²	0.413	0.409	0.409	0.401	0.415	0.410

Note: *, **, *** mean passing the 10%, 5%, 1% significance test respectively , and the t statistics are in the brackets.

(2) Replace the core explanatory variables : This paper selects the proportion of green credit in various loans GLR to replace the original explanatory variables as proxy variables, and the regression results are shown in (3) and (4). After replacing the proxy variable of the core explanatory variable, its regression coefficient is significantly negative at the 10% level, without changing the original conclusion.

(3) Reduce the control variables: On the basis of the control variables selected in the original model, the control variable liquidity ratio LR at the micro level of the bank is eliminated . The regression results are shown in (5) and (6), and the regression coefficient of the core explanatory variable is significantly negative.

The results of various robustness tests support the original conclusion, and the model is robust.

4.3. Heterogeneity Analysis

The previous article analyzed the effect of green credit on the concentration of industry loans, but did not differentiate it from the heterogeneity characteristics. In order to explore the impact of green credit on the credit investment of different commercial banks, the sample was divided into two groups: state-owned bank state and joint-stock bank stock according to the nature of property rights, and divided into a larger group bgroup and a smaller group sgroup according to the size of the bank . The regression results are shown in Table 5.

Table 5. Regression results of heterogeneous grouping

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
wxya	state		stock		bgroup		sgroup	
	fe	re	fe	re	fe	re	fe	re
lnGL	-0.220 ** (-2.46)	0.258 ** (1.97)	-0.0427 (-0.81)	-0.0446 (-0.89)	-0.158 ** (-2.16)	-0.0931 (-1.32)	-0.0312 (-0.51)	-0.0252 (-0.45)
CIR	-0.0793 ** (-2.56)	0.0223 (1.63)	0.0374 *** (3.26)	0.0369 *** (3.34)	-0.0360 * (-1.72)	0.00396 (0.28)	0.0473 *** (3.47)	0.0459 *** (3.56)
ROA	0.770 * (1.88)	-0.887 * (-1.82)	0.439 * (1.79)	0.427 * (1.81)	0.302 (0.96)	0.176 (0.58)	0.499 (1.36)	0.492 (1.44)
CAR	-0.0236 (-0.38)	-0.196 ** (-2.18)	-0.131 *** (-4.05)	-0.132 *** (-4.21)	-0.0526 (-1.21)	-0.0395 (-0.90)	-0.0648 (-1.35)	-0.0579 (-1.26)
LR	0.0182 *** (2.89)	-0.0231 ** (-2.47)	-0.00250 (-0.69)	-0.00248 (-0.71)	0.0130 *** (2.70)	0.0123 ** (2.48)	-0.00131 (-0.27)	-0.00191 (-0.41)
GDPGROWTH	0.0673 * (2.00)	-0.0248 (-0.47)	-0.0307 (-1.19)	-0.0306 (-1.23)	0.0196 (0.74)	0.0111 (0.43)	-0.0471 (-1.54)	-0.0419 (-1.46)
LOANGDP	0.0397 ** (2.54)	-0.0172 (-0.87)	-0.0193 (-1.51)	-0.0193 (-1.57)	0.0183 (1.39)	0.00510 (0.43)	-0.0313 ** (-2.18)	-0.0307 ** (-2.25)
Constant term	8.072 *** (2.71)	-0.0530 (-0.01)	3.658 ** (2.14)	3.768 ** (2.28)	6.582 *** (3.10)	3.825 ** (2.01)	2.533 (1.17)	2.387 (1.20)
N	69	69	99	99	96	96	72	72
R ²	0.358	0.232	0.623	0.623	0.283	0.245	0.537	0.537

Note: *, **, *** mean passing the 10%, 5%, 1% significance test respectively , and the t statistics are in the brackets.

Observing Table 5 (1) and (3), the regression coefficient of the core explanatory variables of the state-owned bank state group is significantly negative, and the absolute value of the regression coefficient of the stock group of joint-stock banks is lower than that of the state-owned bank group, indicating that compared with joint-stock banks, green credit has a better effect on reducing the concentration of state-owned banks' industry loans, and the regression results are in line with research hypothesis 2 . Regression results (5) and (7) show that compared with smaller commercial banks, green credit has a better effect on reducing the concentration of loans in the larger commercial banking industry, and the regression results are in line with research hypothesis 3.

5. Research Conclusion and Policy Recommendations

Based on the annual data of listed commercial banks from 2008 to 2022, this paper studies the impact of green credit on commercial bank loan concentration by constructing a panel data model. After testing the robustness of the model, the samples are divided according to various standards to study the difference in the impact of green credit on different banks. The research conclusions are as follows: First, commercial banks can significantly reduce their industry loan concentration by launching green credit business . Second, compared with joint-stock banks, green credit has a better effect on reducing the industry loan concentration of state-owned banks. Third, compared with smaller commercial banks, green credit has a better effect on reducing the concentration of loans in the larger commercial banking industry. Based on the above research results, this paper puts forward relevant policy recommendations:

(1) Multi-party linkage to build a green credit policy support system and incentive mechanism: The government formulates and improves green credit-related supporting policies and measures through the construction of a green credit policy support system and incentive mechanism, forming a green credit system with assessment, supervision, incentives, and evaluation; it is recommended to set up a green development fund, strengthen cooperation with financial institutions, and effectively leverage social capital to enter the green industry through government funds. Establish a professional green guarantee and green credit risk compensation mechanism. Explore the inclusion of financial institutions' green credit performance in supporting local economic development contributions or financial corporate social responsibility assessments, and regularly monitor and evaluate the effects of green financial development.

(2) Commercial banks need to conduct in-depth exploration, optimization, enrichment and innovation from green credit products to the credit approval process, allocate special credit scales for green projects, and truly realize their multi-faceted support through a series of priority settings for green credit business; provide green financial comprehensive services. Actively use syndicated loans, asset securitization products, etc. to enhance comprehensive service capabilities; strengthen green credit self-evaluation and internal evaluation, and promote the institutionalization and standardization of green credit through various means.

(3) From the technical level, build a green credit data platform, eliminate environmental protection information barriers, and further improve the national and local green finance and environmental protection information exchange and sharing platforms; horizontally link environmental impact assessment departments and commercial banks to regularly publish "green enterprise list or environmental protection project list" as well as green projects and corporate investment and financing, enhance the accuracy of information, and reduce the difficulty of green credit business review.

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