ISSN: 2688-9323

The Impact of Patient Capital on the Carbon Footprint of Bank Loans

-- An Analysis of Mediating Effects based on Bank Operational Risk

Jianhong Tao, Junjie Tong*

School of Economics and Management, Shaanxi University of Science and Technology, Xi'an, 710021, Shaanxi, China

*Corresponding Author: 15713972251@163.com

Abstract

Patient capital's characteristics-including long-term investment and emphasis on sustainable development-align closely with carbon reduction principles, making it a potent driver for effectively lowering the carbon footprint of bank loans. Using a sample of 38 listed commercial banks in China's A-share market from 2010 to 2022 and employing a dual fixed-effects model, this study empirically examines the intrinsic relationship among patient capital, bank operational risk, and the carbon footprint of bank loans. Findings reveal: (1) Increasing the proportion of patient capital in the total equity of listed commercial banks significantly reduces the carbon footprint of bank loans. (2) Patient capital can lower the carbon footprint of bank loans by reducing bank operational risk. (3) This impact exhibits heterogeneity across bank asset size, ownership structure, and capital adequacy. Consequently, banks should leverage patient capital in a tailored manner to achieve a win-win outcome of green low-carbon transformation and risk prevention. Regulatory authorities should strengthen policy guidance and oversight to promote the role of patient capital in banking for green development.

Keywords

Patient Capital; Commercial Banks; Loan Carbon Footprint; Operational Risk.

1. Introduction

Climate change represents the most significant global development and security threat of the 21st century [1]. Against the backdrop of increasingly severe global climate challenges, reducing carbon emissions and advancing low-carbon transformation have become a shared mission for the international community. China has actively responded to global efforts by proposing its “dual carbon” goals in 2020. As the backbone of the financial system, commercial banks' loan portfolio carbon footprint-the greenhouse gas emissions indirectly generated through credit resource allocation or the indirect carbon emissions resulting from credit flows to specific industries-directly impacts the achievement of national emission reduction targets[2]. The carbon footprint of bank loans reflects financial institutions' responsibility and influence in climate change. With the deepening implementation of the Paris Agreement and the refinement of global carbon pricing mechanisms, accurately accounting for and effectively reducing the carbon footprint of bank loans has become a core issue for the sustainable development of the banking industry.

Traditional financial models often pursue short-term returns, creating an inherent conflict with the long-term investments required for low-carbon transition. Patient Capital emerges as a

ISSN: 2688-9323

novel capital form in this context, defined as "a capital form focused on long-term investment, with a longer-term perspective on capital returns and higher risk tolerance." By absorbing long-term liabilities and increasing institutional investor holdings, banks can access more stable funding sources. This enhances their risk tolerance and fosters a long-term investment outlook, prompting greater attention to the carbon footprint of loan portfolios.

Currently, research on patient capital and the carbon footprint of bank loans remains relatively fragmented. Studies on patient capital predominantly focus on technological innovation sectors. Z.Y. Jiang and F.X. Wu [3], M.J. Wu et al. [4], and S.F. Li and L. Wen[5] have respectively examined the impact of patient capital on corporate innovation efficiency, corporate performance, and corporate ESG performance, all of which are studies at the corporate level. Conversely, research on the carbon footprint of bank loans primarily centers on risk management [6-7], lacking systematic analysis that integrates both concepts. Theoretically, however, the impact of patient capital on the carbon footprint of bank loans can be mediated through the intermediary variable of bank operational risk. When banks secure sufficient patient capital, their funding structure improves. This safeguards capital chains during market volatility, preventing crises triggered by liquidity issues. It mitigates managers' short-term incentives driven by capital market pressures[8], reduces liquidity risks and speculative behaviors caused by short-term market fluctuations, enhances banks' risk resilience, and lowers their operational risks. Reduced operational risk encourages banks to actively pursue green finance and decrease lending to high-carbon projects [9], thereby effectively reducing the carbon footprint of bank loans.

Does patient capital influence the carbon footprint of bank loans, and if so, how? This question warrants further exploration. Therefore, this paper utilizes data from 38 listed commercial banks on the A-share market between 2010 and 2022. From the perspective of equity stability, it empirically examines the impact of patient capital on the carbon footprint of bank loans and its underlying mechanisms, while also analyzing the differential effects of patient capital on this carbon footprint.

2. Research Hypotheses

2.1. Research Hypotheses

2.1.1. Direct Effect of Patient Capital on Bank Loan Carbon Footprint

Patient capital investments are characterized by long investment horizons, high risk tolerance, and strategic orientation [10]. The carbon footprint of bank loans typically refers to greenhouse gas emissions indirectly generated through banks' credit resource allocation or indirect emissions resulting from credit flows to specific industries. Banks can reduce carbon emissions from lending by increasing loans to green projects or decreasing loans to high-carbon industries.

Considering the characteristics of patient capital: First, patient capital inherently possesses long-term and stable attributes. Unlike short-term profit-seeking capital, patient capital represents investments focused on long-term value creation[11], with investment cycles typically spanning economic fluctuations. A higher proportion of patient capital alleviates banks' profitability pressures, enabling tolerance for the high-investment, low-return characteristics of green transition projects in their early stages. By funding such projects, banks can optimize their credit structures, reduce reliance on high-carbon short-term projects, and thereby lower the overall carbon intensity of their loan portfolios. Secondly, patient capital exhibits greater risk tolerance. Green transition projects often involve complex challenges such as technological uncertainty, policy change risks, and market acceptance risks[12]. Traditional capital, with its risk-averse tendencies, may shy away from such investments. However, banks with a higher proportion of patient capital can leverage its unique risk-diversification mechanisms and greater loss-absorption capacity to provide a “risk buffer” for green innovation projects. This differentiated risk appetite enables banks, supported by patient capital, to allocate credit resources more readily toward high-risk, high-return areas like low-carbon technology R&D and green industrial upgrading, thereby driving a structural reduction in the carbon footprint of their loan portfolios. Finally, patient capital exhibits a distinct strategic orientation. Under the constraints of the “dual carbon” goals, regulators guide patient capital toward serving national strategic transitions through policy tools like green credit guidelines and carbon reduction support instruments. This policy direction compels banks to balance commercial sustainability with environmental and social benefits when allocating patient capital. Banks proactively adjust industry credit policies, restricting lending to high-energy-consuming sectors while expanding credit to green areas like clean energy and environmental protection, ultimately achieving proactive management of loan carbon footprints. Based on the above theoretical analysis, we propose Hypothesis H1.

H1: The higher the proportion of patient capital in the total equity capital of listed commercial banks, the lower their loan carbon footprint.

2.1.2. Analysis of Mediating Effects based on Bank Operational Risk

As a form of long-term, stable investment capital focused on sustainable development value, patient capital can influence banks' lending direction through signaling mechanisms, thereby reducing their loan carbon footprint. Specifically, the infusion of patient capital provides enterprises with stable financial support [13], mitigates managers' short-term incentives driven by capital market pressures [8], reduces liquidity risks and speculative behaviors caused by short-term market fluctuations, and enhances banks' risk resilience. Banks can invest in technology enterprises through equity participation, supporting their long-term growth and reducing portfolio volatility. Furthermore, banks with reduced operational risks are more inclined to practice green finance principles. Banks with lower operational risks typically possess stronger risk management capabilities and long-term strategic vision. They proactively adjust credit structures to reduce exposure to high-carbon assets, redirecting funds from high-risk, high-carbon industries toward low-carbon sectors [9], thereby lowering the carbon footprint of bank loans. Based on this theoretical analysis, we propose Hypothesis H2.

H2: Patient capital reduces banks' operational risks, thereby lowering the carbon footprint of bank loans.

3. Research Design

3.1. Model Construction

To better examine the impact of patient capital on bank loan carbon footprints while accounting for bank heterogeneity, regression model (1) is constructed. If increased patient capital reduces bank loan carbon footprints, α_1 in model (1) will be significantly negative.

$$Cbl_{it} = \alpha_0 + \alpha_1 Invest_{it} + Controls + \Sigma Bank + \Sigma Year + \varepsilon_{it} \tag{1}$$

where Cblit denotes the carbon footprint of bank loans for bank i in year t, Investit represents the shareholding ratio of stable institutional investors in bank i in year t, and Controls are control variables including loan growth rate (Gd), deposit growth rate (Gde), non-performing loan ratio (Npl), asset size (Size), return on assets (Roa), capital adequacy ratio (Car), business risk (Brisk), net interest margin (Nim), interest income ratio (Nii), and largest shareholder ownership ratio (Top1). ∑Bank controls for bank fixed effects, ∑Year controls for time fixed effects, and εit represents the random error term.

3.2. Variable Definitions

3.2.1. Bank Loan Carbon Footprint

Following the methodology of Ren Dani and Zheng Liujiang [14] on bank loan carbon emissions, the bank loan carbon footprint indicator is constructed in three steps. First, calculate the average carbon emissions (tonnes) per 10,000 yuan of credit balance for industry j (C_j) based on industry carbon emissions (E_j) and industry credit balance (L_j). Second, calculate the product of Bank i's loan balance to Industry j and the carbon emissions per 10,000 yuan of credit balance for Industry j. Sum these values across all industries to obtain Bank i's total carbon emissions. Third, calculate the carbon emissions supported per 10,000 yuan of loans by Bank i-the bank's credit carbon emission intensity indicator, i.e., the bank credit carbon footprint. Specific calculations are as follows:

Average carbon emissions per 10,000 yuan of credit balance for industry j (tons):

$$C_j = \frac{E_j}{L_j} \tag{2}$$

Carbon emissions generated by Bank i's loans to industry j:

$$E_{ij} = L_{ij} \times C_j = L_{ij} \times \frac{E_j}{L_j} \tag{3}$$

Total carbon emissions of Bank i:

$$E_i^{total} = \sum_j (E_{ij}) = \sum_j (L_{ij} \times \frac{E_j}{L_j}) \tag{4}$$

Bank i's credit carbon footprint (tons/10,000 yuan):

$$Cbl_i = \frac{E_i^{total}}{L_i} = \frac{\sum_j (L_{ij} \times \frac{E_j}{L_j})}{\sum_j L_{ij}} \tag{5}$$

Where:

E_j: Annual carbon emissions of industry j (tons)

L_j: Credit balance of industry j (10,000 yuan)

L_{ij}: Bank i's loan balance to industry j (10,000 yuan)

L_i: Bank i's total credit balance (10,000 yuan), $L_i = \sum_j L_{ij}$

3.2.2. Patient Capital

This paper measures patient capital from the perspective of stable equity (Invest). Referencing the research by M.J. Wu et al. [4], the institutional investor stability indicator (Pc) is calculated as the ratio of the investor shareholding ratio of company i in year t to the standard deviation of its shareholding ratios over the past three years.

$$Pc_{i,t} = Invest_{i,t} / STD(Invest_{i,t-1}, Invest_{i,t-2}, Invest_{i,t-3}) \tag{6}$$

ISSN: 2688-9323

3.2.3. Mediating Variable

Operational Risk. Measured using the logarithm of the ratio of return on assets to its standard deviation (Brisk). A higher Brisk value indicates greater bank stability and lower operational risk; conversely, a lower Brisk value signifies higher operational risk.

3.2.4. Control Variables

Drawing on existing research, the following nine bank-level control variables are selected: Loan Growth Rate (Gd), measured as the ratio of loans to the previous year's loan amount minus one; Deposit Growth Rate (Gde), measured as (Ending Balance - Beginning Balance) / Beginning Balance; Non-Performing Loan Ratio (Npl), measured as the ratio of total non-performing loans to total loans; Asset size (Size), obtained by taking the logarithm of total bank assets; Return on assets (Roa), measured as net profit divided by total assets, expressed as an average: Roa = (Net profit × 2) / (Beginning total assets + Ending total assets) × 100%; Capital Adequacy Ratio (Car) is expressed as the ratio of total capital to risk-weighted assets; Net Interest Margin (Nim) is measured by the difference between interest-earning assets and interest-bearing liabilities; Net Interest Income Ratio (Nii) is calculated as the ratio of interest income to total income; Top Shareholder Holding Ratio (Top1) is measured by the shareholding percentage of the largest shareholder.

3.3. Data Sources and Description

To ensure the validity of the analysis, missing values and bank data with fewer than three years of records were excluded. This yielded panel data for 38 listed commercial banks covering the period from 2010 to 2022. Commercial bank data were sourced from the Guotai An database, bank financial statements, the China Financial Yearbook, and the Resset database.

Descriptive statistics for key variables are presented in Table 1. The mean of patient capital (Pc) is 4.274 with a standard deviation of 4.385, ranging from a maximum of 36.222 to a minimum of 0.565, indicating substantial variation in institutional investor stability (Pc) across the sample. The mean value of bank loan carbon footprint (Cbl) is 2.468, with a standard deviation of 0.708, maximum value of 5.119, and minimum value of 0.646. This indicates substantial variation in bank loan carbon footprint (Cbl) across the study samples. Descriptive statistics for the remaining control variables fall within reasonable ranges.

Table 1. Descriptive Statistics of Key Variables

Variable Name	Variable Symbol	N	Mean	Std. Dev	Min	Max
Patient Capital	Pc	307	4.274	4.385	0.565	36.222
Carbon Footprint of Bank Loan	Cbl	307	2.468	0.708	0.646	5.119
Growth Rate	Gd	307	0.149	0.059	0.015	0.438
Deposit Growth Rate	Gde	307	0.125	0.073	-0.068	0.453
Non-Performing Loan Ratio	Npl	307	1.268	0.377	0.380	2.390
Asset Size	Size	307	28.419	1.565	25.00	31.310
Return on Assets	Roa	307	0.958	0.218	0.446	1.643
Capital Adequacy Ratio	Car	307	13.497	1.675	9.880	19.260
Business Risk Brisk	Brisk	307	1.454	0.231	0.716	2.020
Net Interest Margin	Nim	307	2.189	0.416	1.320	3.849
Interest Income Ratio	Nii	307	23.277	8.651	5.823	51.090
Largest Shareholder Holding Ratio	Top1	307	25.670	17.495	4.180	67.720

ISSN: 2688-9323

4. Empirical Results and Analysis

4.1. Benchmark Regression Results

Table 2 reports the benchmark regression results on the impact of patient capital on the carbon footprint of bank loans. Columns (1) and (2) in Table 2 present the regression results without controlling for bank and year effects, respectively: one without any control variables and the other with control variables included. The results show that the regression coefficients are all positive, contrary to the hypothesized results, and none are statistically significant. Columns (3) and (4) of Table 2 present regressions controlling for bank and year fixed effects, with and without additional control variables. Both sets of results show negative regression coefficients that are statistically significant at the 1% level. This indicates a significant negative correlation between patient capital investment and the carbon footprint of bank loans, suggesting that the carbon footprint decreases as the proportion of patient capital sources in banks increases. This preliminary validation supports Hypothesis H1.

Table 2. Benchmark Regression Results

Variable	(1)	(2)	(3)	(4)
	Cbl	Cbl	Cbl	Cbl
Pc	0.0052	0.0014	-0.0068***	-0.0129***
	(0.0063)	(0.0082)	(0.0019)	(0.0017)
Gd		-0.3919		-0.8942***
		(0.7746)		(0.2583)
Gde		0.1620		0.2126
		(0.7873)		(0.1942)
Npl		-0.2672		0.0341
		(0.1659)		(0.0728)
Size		0.0761*		0.3345**
		(0.0442)		(0.1405)
Roa		0.5612*		-0.3297*
		(0.3024)		(0.1898)
Car		-0.0437**		0.0056
		(0.0175)		(0.0119)
Nim		0.5100***		0.2778***
		(0.1256)		(0.0618)
Nii		-0.0068		0.0115***
		(0.0050)		(0.0036)
Top1		0.0049*		-0.0036*
		(0.0026)		(0.0020)
_Cons	2.4462***	-0.3572		-7.4589*
	(0.0527)	(1.0668)		(4.0459)
Bank	NO	NO	YES	YES
Year	NO	NO	YES	YES
N	307	307	306	306
r2_a	-0.002	0.317	0.932	0.942

Note: * p<0.1; ** p<0.05; ***, p<0.01. The values in parentheses represent robust standard errors.

Among the influencing factors, the regression coefficients for loan growth rate (Gd), net interest margin (Nim), and interest income ratio (Nii) are all statistically significant at the 1% level. The regression coefficient for loan growth rate (Gd) is negative, indicating that an increase in bank loan growth rate at this stage is conducive to reducing the carbon footprint of bank loans. Conversely, the estimated coefficients for net interest margin (Nim) and interest income ratio (Nii) are positive, suggesting that the current expansion of banks' net interest margin and increase in interest income ratio will increase the carbon footprint of bank loans. The regression coefficient for bank size is positive and significant at the 5% level, suggesting that current bank size expansion may increase the carbon footprint of bank loans. The regression coefficients for return on assets (Roa) and the proportion of the largest shareholder are both negative and significant at the 10% level, indicating that increases in ROA and the proportion of the largest shareholder are beneficial for reducing the carbon footprint of bank loans.

4.2. Robustness Tests

4.2.1. PSM Test

To address sample selection bias, robustness testing was conducted using propensity score matching (PSM). Step 1: Constructed a dummy variable using the median of patient capital as the threshold, assigning a value of 1 if above the median and 0 otherwise. Second, using this dummy variable as the treatment variable, loan growth rate, deposit growth rate, non-performing loan ratio, asset size, and other control variables as covariates, and bank loan carbon footprint as the outcome variable, perform one-to-one nearest neighbor matching; Third, use the matched data to re-run the regression based on the benchmark regression model. Specific results are shown in Table 3.

Table 3. Robustness Test Results

Variable	(1)	(2)	(3)	(4)
	PSM	Heckman	Substitute Variable	Partial Sample Exclusion
L1_pc			-0.0064***	
			(0.0017)	
Pc	-0.0095***	-0.0105***		-0.0129***
	(0.0015)	(0.0016)		(0.0022)
Imr		0.0724***		
		(0.0184)		
_Cons	-11.2442	-7.3247*	-5.1248	-5.4916
	(6.6338)	(4.1756)	(3.9510)	(4.8269)
Controls	YES	YES	YES	YES
Bank	YES	YES	YES	YES
Year	YES	YES	YES	YES
N	199	306	265	213
r2_a	0.918	0.945	0.930	0.938

Note:* p<0.1; ** p<0.05; ***, p<0.01. The values in parentheses represent robust standard errors.

Column (1) of Table 3 shows that the regression coefficient for patient capital on the carbon footprint of bank loans is -0.0095 and remains statistically significant at the 1% level, indicating the robustness of our analysis results.

4.2.2. Heckman Two-Stage Model

To further examine potential sample selection bias, estimation was conducted using the Heckman two-stage model. First, a Probit model was employed for the first-stage estimation.

The dummy variable for bank loan carbon footprint (assigned a value of 1 if above the median, 0 otherwise) served as the dependent variable, while control variables acted as explanatory variables. This yielded the inverse Mills ratio (IMR). Finally, the IMR was incorporated into the benchmark regression model for the second stage. The results in Column (2) of Table 3 indicate that the regression coefficient for patient capital is -0.0105 and is significantly negative at the 1% level, confirming the robustness of the research conclusions.

4.2.3. Substituting Explanatory Variables

By employing a lagged period of patient capital in the regression analysis, we can observe whether patient capital exerts a delayed effect on the carbon footprint of bank loans. The regression results in Column (3) of Table 3 show that compared to the benchmark regression, the regression coefficient for lagged patient capital is -0.0064, which is greater than the benchmark result of -0.010. This indicates that the effect of patient capital on reducing the carbon footprint of bank loans weakens over time. However, the impact of patient capital on the carbon footprint remains negative and statistically significant, confirming the validity of the research conclusion.

4.2.4. Partial Sample Exclusion

Considering the impact of exogenous shocks on bank loan carbon footprint, following G.Y. Yang and L. Tang [15], we excluded samples from three financial exogenous shock events (2010, 2015 and 2016, 2020) and reran the regression. The results in Column (4) of Table 3 show a regression coefficient of -0.0129, significant at the 1% level. This aligns with the direction of the benchmark regression results regarding the impact of patient capital on the carbon footprint of bank loans and remains statistically significant, indicating that the research conclusions are robust.

5. Mechanism Testing and Heterogeneity Analysis

5.1. Mechanism Testing

To verify whether patient capital influences banks' lending carbon footprint by affecting their risk-taking behavior, refer to the study by T. Jiang [16] to construct the following regression model:

$$Medium_{it} = \beta_0 + \beta_1 \, Invest_{it} + Controls + \Sigma Bank + \Sigma Year + \varepsilon_{it} \tag{7}$$

$$Cbl_{it} = \omega_0 + \omega_1 Invest_{it} + \omega_2 Medium_{it} + Controls + \Sigma Bank + \Sigma Year + \varepsilon_{it} \tag{8}$$

Medium serves as the mediator variable. Specifically, Brisk is adopted as the indicator for bank operational risk, while the remaining variables remain consistent with the baseline regression model. Table 4 presents the results examining the impact mechanism of patient capital on the carbon footprint of bank loans. The first column displays the results of the benchmark regression model, with a regression coefficient of -0.0129, significant at the 1% level. The second column shows the regression results of patient capital on the mediating variable of operational risk, with a regression coefficient of 0.0007, significant at the 10% level. This indicates that an increase in patient capital can elevate the Brisk score and reduce the operational risk of banks. The third column presents the regression results for Model (8). ω1 is -0.0119, whose absolute value is smaller than that of the total effect -0.0129 in the benchmark regression and is significant at the 1% level. ω2 is -1.3975 and is significant at the 5% level, indicating that banks' risk-taking plays a partial mediating role in the impact of patient capital on the carbon footprint of bank loans.

Table 4. Mechanism Test

Variable	(1) Cbl	(2) Brisk	(3) Cbl
Pc	-0.0129***	0.0007*	-0.0119***
	(0.0017)	(0.0004)	(0.0016)
Brisk			-1.3975**
			(0.5231)
_Cons	-7.4589*	0.3024	-7.0363*
	(4.0459)	(0.7273)	(3.6552)
Controls	YES	YES	YES
Bank	YES	YES	YES
Year	YES	YES	YES
N	306	306	306
r2_a	0.942	0.988	0.945

Note:* p<0.1; ** p<0.05; ***, p<0.01. The values in parentheses represent robust standard errors.

5.2. Heterogeneity Analysis

5.2.1. Differences in Bank Asset Size

To examine whether the impact of resilient capital on bank loan carbon footprint varies across banks of different asset sizes, this paper takes the median asset size as the boundary, and divides the overall sample into a small asset size and a large asset size (greater than or equal to the median) and two sub-samples to re-register, The results are presented in Table 5.

Table 5. Heterogeneity Test Results

Variable	Asset Size		Ownership		Capital Adequacy	
	(1)Small	(2)Large	(3)SOE	(4)NON-SOE	(5)Adequate	(6)deficient
Pc	-0.0121***	-0.0086	-0.0116***	0.0220	-0.0088*	-0.0148***
	(0.0035)	(0.0147)	(0.0023)	(0.0132)	(0.0050)	(0.0034)
_Cons	-11.3430	-9.8472	-3.9299	-12.8640***	-4.5341	-9.0997
	(8.1078)	(6.7272)	(4.7266)	(3.6861)	(7.9459)	(5.9062)
Controls	YES	YES	YES	YES	YES	YES
Bank	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
N	149	152	203	103	151	147
r2_a	0.951	0.919	0.940	0.964	0.956	0.938

Note:* p<0.1; ** p<0.05; ***, p<0.01. The values in parentheses represent robust standard errors.

Columns (1) and (2) of Table 5 show the corresponding regression results. The results show that the estimated coefficient of patient capital is -0.0121 and passes the significance test at the 1% level in the small asset-size sample, while the estimated coefficient of patient capital is -0.0086 and insignificant in the large asset-size sample, which suggests that patience capital investment is more beneficial to small asset-size banks to reduce the carbon footprint of their bank loans compared to large asset-size banks. The reason may lie in the fact that small asset-size banks have relatively single business structure and high flexibility of adjustment, and patient capital investment can quickly guide them to focus on low-carbon loan projects and optimize credit allocation. While large asset-size banks have complex organizational structure, diversified business and long decision-making process, it is difficult to quickly and effectively promote the transformation of loan structure to low-carbon, so the effect of reducing the carbon footprint of loans is not as significant as that of small asset-size banks.

5.2.2. Differences in Ownership

The effect of patient capital on the carbon footprint of bank loans may be different due to differences in ownership, so this paper refers to W.B. He and M.X. Gong [17], the sample is divided into state-owned enterprises and non-state-owned enterprises, and regression is carried out separately, and the regression results are shown in columns (3) and columns (4) of Table 5, in the sample of state-owned enterprises, the regression coefficient is -0.0116, which is consistent with the baseline regression and significant at the significant at 1% level, while the regression coefficient of non-SOE banks is 0.0220, the sign of the regression coefficient is opposite to the benchmark regression and non-significant, which indicates that patient capital is more effective in promoting the reduction of the carbon footprint of bank loans in SOEs, and on the contrary, it may increase the carbon footprint of bank loans in non-SOEs. The possible reason for this result is that SOEs, which are more constrained by policy orientation and social responsibility, have incentives to respond to the call for green finance and utilize patient capital to promote lending to low-carbon areas. On the other hand, non-state-owned enterprises, whose main goal is profitability and lack of strong external policy constraints, may focus more on short-term gains when utilizing patient capital, investing funds in traditional high-carbon but quick-return projects, leading to an increase in the carbon footprint of loans instead of a decrease.

5.2.3. Capital Adequacy Differences

In order to analyze whether differences in capital adequacy affect the role of patient capital on the carbon footprint of bank loans, this paper takes the median of the capital adequacy ratio of the sample data as the criterion, divides the sample into well-capitalized banks (greater than or equal to the median) and under-capitalized banks, and conducts regressions separately. The regression results are shown in Column (5) and Column (6) of Table 5, the regression coefficients are -0.0088 and -0.0148, respectively, and the regression coefficients are negative and pass the significance test, but the absolute value and significance of the regression coefficients for the capital-shortage banks are larger than those for the well-capitalized banks. The reason for this may be that capital-starved banks face more urgent capital replenishment and risk control pressure, and have a more urgent need for long-term stable funds such as patient capital. In order to attract patient capital, capital-starved banks have more incentives to adjust their loan structure and increase support for low-carbon projects, thus reducing the carbon footprint of their loans more significantly. While well-capitalized banks are relatively well-funded and lack sufficient external pressure to push them to vigorously promote the green transformation of their loan structure, the impact of patient capital on their loan carbon footprint is relatively weak, and the regression coefficients are smaller than those of capital-shortage banks in both absolute value and significance.

6. Conclusion and Policy Recommendations

6.1. Research Conclusion

Based on the sample data of 38 listed commercial banks from 2010 to 2022, the impact of patient capital on the carbon footprint of bank loans is empirically examined. It is found that (1) patient capital can reduce the carbon footprint of bank loans; (2) patient capital can reduce the carbon footprint of bank loans by lowering the bank's operational risk, and then reduce the carbon footprint of bank loans; and (3) there is a heterogeneous effect of patient capital on the carbon footprint of bank loans, i.e., the negative effect of patient capital on the carbon footprint of bank loans is more pronounced in the banks with smaller asset sizes, state-owned enterprises, capital shortages, and those in North China. This heterogeneity may be due to the fact that small-sized banks have a short decision chain and can respond faster to the orientation of patient capital; SOEs are subject to strong policy constraints and are more active in practicing green finance; capital-shortage banks rely heavily on patient capital and prioritize green projects; and strict environmental protection regulation in North China prompts banks to borrow patient capital to accelerate low-carbon transformation.

6.2. Recommendations

Based on the above conclusions, this paper puts forward the following policy recommendations from the levels of banks and regulators:

First of all, the level of banks. First, at the bank level, banks should make use of patient capital to realize a win-win situation in green low-carbon transformation and risk prevention and control. First, small-sized banks, with flexible decision-making, should take the initiative to cooperate with patient capital holders to increase investment in green small and micro-enterprises and environmental protection projects, optimize the credit structure and reduce risks. Second, state-owned banks should further strengthen their policy orientation, incorporate green finance into the core of their strategy, and utilize their own financial strength and brand advantages to attract more patient capital investment, carry out green financial innovation, and reduce operational risks. Third, banks in North China should seize the opportunity to accelerate low-carbon transformation with the help of patient capital, while banks in other regions should also pay attention to the dynamics of local environmental protection policies and layout green finance in advance.

Second, regulators. Regulators should strengthen policy guidance and supervision to promote the banking industry's patient capital to help green development. First, the introduction of relevant policies to guide banks to increase the proportion of patient capital. On the one hand, formulate encouraging policies, such as tax incentives and financial subsidies for banks with a high proportion of patient capital, so as to increase the enthusiasm of banks to introduce patient capital. On the other hand, strengthen the supervision on the introduction of patient capital by banks, standardize the recognition criteria and investment behavior of patient capital, and prevent banks from taking advantage of policy loopholes to operate in violation of the law. Second, implement differentiated supervision for banks of different types and regions. Simplify the approval process, provide policy advice and guidance services for small-scale banks to help them better utilize patient capital to realize green transformation; require state-owned banks to play a demonstration role in green development and strengthen supervision of its implementation; encourage banks in regions with strict environmental protection regulation to increase green financial innovation and explore green financial development models suitable for the local area.

References

[1] IPCC. Climate change 2021:the physical science basis.Contribution of working group I to the Sixth assessment report of the intergovernmental panel on climate change[M].Cambridge University Press,2021.

[2] Teubler J, Kuehlert M. Financial carbon footprint: calculating banks' scope 3 emissions of assets and loans[C]. European Council for an Energy Efficient Economy, 2020.381-389.

[3] Z.Y. Jiang, F.X. Wu. Patient Capital, Digital Economy and Innovation Efficiency: Empirical Evidence Based on A-Share Listed Companies in Manufacturing Industry [J]. Journal of Hohai University(Philosophy and Social Sciences), 2024, 26(02): 121-133.

[4] M.J. Wu, P Zhang, Z.Y. Zhao. The Impact of Patient Capital and Innovation Investment on Corporate Performance： Based on the Data of Small and Medium-sized Board Listed Companies [J]. Scientific Decision Making, 2022(09):55-72.

[5] S.F. Li, L.Wen. Research on the Influence of Patience Capital on ESG Performance of Enterprises [J]. On Economic Problems, 2025(01):48-56.

[6] GUAN, RONG, ZHENG, HAITAO, HU, JIE, et al. The Higher Carbon Intensity of Loans, the Higher Non-Performing Loan Ratio: The Case of China[J]. Sustainability,2017,9(4):667.

[7] X. Deng, S.T. Gan, L.M. Chen. The impact of bank carbon risk on loan risk [J]. Systems Engineering-Theory & Practice, 2025, 45(02): 408-428.

[8] Z.H. Liu. The Logical Basis, Key Issues, and Practical Approaches for Strengthening Patient Capital in the Stage of High-Quality Development. [J]. Academic Journal of Zhongzhou, 2025, (01): 32-39.

[9] X.J. Chen, G. Yang, N. Wang. Carbon Risk Pricing: Evidence from China's Municipal Investment Bonds Market [J]. Contemporary Finance & Economics, 2024, (12): 54-67. DOI: 10.13676/j.cnki.cn36-1030/f.20240802.001.

[10] L. Tang, G.Y. Yang. A Study of the Impact of Patient Capital Investment on Corporate ESG Performance [J]. China Business and Market,2025,39(02):86-99.

[11] Ivashina V ,Lerner J .Patient Capital:The Challenges and Promises of Long-Term Investing[M]. Princeton University Press:2019-01-01

[12] H.R. Wei, J Zhang. Digital Enabling, Environmental Regulation and Green Transformation of Manufacturing Enterprises [J/OL]. Collected Essays on Finance and Economics,1-16. [2025-7-27].https://doi.org/10.13762/j.cnki.cjlc.20250513.003.

[13] Y.F. Zhang, M.F. Lu. Patient Capital and High Quality Development: Attribute Characteristics, Reality and Countermeasures[J]. Journal of Financial Development Research,2024,(11):88-92.

[14] D.N. Ren, L.J. Zheng. Carbon Emission Intensity of Credit,Green Finance and Business Performance of Commercial Banks [J]. Journal of Regional Financial Research,2023(05):66-73.

[15] G.Y. Yang, L. Tang. The Impact of Patient capital on Business Resilience[J]. Finance & Economics,2025(03):15-29.

[16] T. Jiang. Mediating Effects and Moderating Effects in Causal Inference[J]. China Industrial Economics,2022(05):100-120.

[17] W.B. He, M.X. Gong. Can Patient Capital Alleviate Overcapacity?--From the Perspective of Capacity Utilization Rate of Listed Companies[J]. Contemporary Economic Research,2025(01):85-100.