# ЭКОНОМИКА ЖӘНЕ БИЗНЕС
# ECONOMY AND BUSINESS
# ЭКОНОМИКА И БИЗНЕС

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## AN EMPIRICAL ANALYSIS OF GREEN CREDIT
## ON THE OPERATIONAL PERFORMANCE
## OF CHINESE LISTED COMMERCIAL BANKS

### Abstract

To delve deeper into how green credit influences the performance of China's listed commercial banks, this study investigates 16 publicly listed banks as research samples. The study aimed to analyze the impact of Green Credit on the Operational Performance of Chinese Listed Commercial Banks. The performance levels of these banks are assessed using factor analysis, and the effects of green credit are examined through fixed-effects and moderating effect models. The results suggest that, given the relatively recent adoption of green credit policies and the still-developing institutional framework in China, green credit currently shows a negative association with bank performance. Moreover, corporate social responsibility (CSR) plays a moderating role that amplifies this adverse effect. Nonetheless, in the long run, promoting green credit remains a necessary and inevitable direction. With ongoing improvements in green credit mechanisms, commercial bank performance is expected to improve, fostering both ecological sustainability and economic growth.

**Keywords:** green finance, bank performance, factor analysis, ESG, green credit.

## Introduction

In recent years, the concept of green finance has gained significant global traction amid growing concerns about climate change, environmental degradation, and the need for sustainable development. As a core component of green finance, green credit aims to guide financial resources toward environmentally friendly and low-carbon sectors, thereby aligning economic activities with ecological goals. In the context of China's transition to a green economy and its commitment to achieving carbon peak and neutrality goals, green credit has emerged as a critical policy instrument for encouraging sustainable investment and transforming traditional industries. Commercial banks, serving as key intermediaries in the financial system, are not only responsible for allocating capital

efficiently but also increasingly expected to integrate environmental, social, and governance (ESG) considerations into their business strategies.

Despite the strategic importance of green credit, its actual impact on bank performance remains an open empirical question. On one hand, green credit initiatives may offer long-term benefits, such as reduced credit risk, stronger stakeholder trust, and reputational gains. On the other hand, banks often face short-term trade-offs, including higher project risk, limited returns, and compliance costs. These practical constraints raise concerns about whether green credit undermines banks' financial performance, particularly in the early stages of policy implementation when regulatory mechanisms and market incentives are still evolving. Moreover, the interplay between green credit and corporate social responsibility (CSR) may further complicate performance outcomes, as CSR initiatives, while socially beneficial, may also increase operational expenditures in the short run.

Against this backdrop, this study seeks to empirically assess the impact of green credit on the operational performance of Chinese listed commercial banks, with a focus on the moderating role of CSR. By selecting 16 publicly listed commercial banks as the research sample, this study employs factor analysis to evaluate bank performance and uses fixed-effects and moderating effect models to investigate the relationship between green credit and performance outcomes. The goal is to provide empirical evidence on whether the adoption of green credit strategies aligns with banks' financial interests and to what extent CSR influences this relationship. The findings aim to offer theoretical insights and practical implications for policymakers, financial institutions, and stakeholders striving to promote both economic growth and environmental sustainability in China's financial sector.

**Materials and Methods**

In recent years, the role of green credit in advancing sustainable finance has attracted growing academic attention, particularly in the Chinese context. Scholars have explored green credit as both a regulatory tool and a market-driven mechanism to redirect capital toward environmentally responsible sectors. Zhang et al. investigated the early implementation of China's green credit policy, highlighting a mismatch between top-down policy design and bottom-up institutional execution [9]. Liu and Guo provided empirical evidence that, although green credit policies are environmentally beneficial, they may exert negative short-term effects on bank profitability due to high project risks and delayed returns [10].

Other studies emphasize the long-term potential of green credit. Weber and Luo et al. examined the relationship between corporate sustainability practices and financial performance in Chinese banks, showing that while CSR may increase operating costs, it can also enhance reputation and stakeholder trust [11, 12]. Yu and Zhang found that green credit policies can drive innovation among highly polluting firms, improving borrower quality and indirectly affecting bank-level credit risk [13].

From a broader policy perspective, Wang and Zhi emphasized that the success of green finance, including green credit, depends on the synergy between market incentives and institutional support [14]. Building on this, Huang et al. empirically demonstrated how green credit policy influences credit allocation efficiency and bank performance across commercial banks, with institutional maturity and strategic orientation playing a critical role [15]. Despite these insights, few studies have systematically examined how CSR moderates the relationship between green credit and bank performance, particularly in the context of ESG-oriented expectations for listed commercial banks. This study seeks to fill that gap through empirical analysis.

Existing literature presents conflicting perspectives. Some scholars argue that green credit improves bank performance, while others contend it imposes financial burdens. For instance, Cui Yujun et al. found that implementing green credit policies significantly reduces credit risks for commercial banks, thereby enhancing both environmental and financial performance [1]. Li Su et al., using a difference-in-differences approach, concluded that green credit not only boosts bank performance but also mitigates credit risks [2]. Conversely, Wright asserted that adopting the Equator Principles increases operational costs, leading to reduced profitability [3]. Hu Rongcai et

al. demonstrated that green credit initially diminishes profitability, but the negative impact gradually diminishes as loan portfolios expand [4].

Impact of Green Credit on Commercial Bank Performance. On one hand, green credit initiatives may enhance the performance of commercial banks.

Business Structure Perspective: Growing environmental awareness, supported by national policies, has driven increasing demand for green credit from both individuals and enterprises committed to environmental protection and social responsibility. By issuing green loans and bonds, banks can expand their service portfolios, channel more green capital into the financial system, and diversify revenue streams, thereby improving profitability while shifting away from traditional business models.

Reputational Benefits: A strong reputation serves as intangible capital for banks. Green credit helps banks bolster their public image and mitigate reputational risks associated with environmental harm. Over the long term, proactive engagement in green credit demonstrates corporate social responsibility (CSR), fostering trust among stakeholders, attracting high-quality clients, and indirectly boosting performance.

On the other hand, green credit may also undermine bank performance.

Cost Challenges: China's underdeveloped green credit infrastructure necessitates substantial upfront investments in human and financial resources, raising operational costs. Preferential interest rates for green enterprises, mandated by national policies, may further reduce interest income and create short-term profitability pressures. Additionally, banks risk losing clients from high-pollution, high-energy-consumption, and overcapacity industries (often termed "two highs and one surplus" enterprises), leading to revenue losses and opportunity costs.

Risk Exposure:

◆ Liquidity Risks: Green projects often involve long-term loans with extended payback periods. If loan maturities fall short of project cash flow timelines, banks face liquidity strain and delayed fund recovery.

◆ Credit Risks: Green loans, predominantly medium- to long-term, may increase non-performing loan ratios if borrowers default, discouraging banks from prioritizing green investments.

◆ Technological and Market Risks: Innovative green projects carry inherent uncertainties, including unproven technologies and volatile market demand.

◆ Reputational Risks: Rigorous environmental due diligence is required for green credit approvals. Oversights in assessing pollution control measures could exacerbate environmental damage, harming a bank's reputation.

Hypothesis 1: Green credit negatively impacts the performance of China's listed commercial banks.

Corporate social responsibility (CSR) serves as a critical indicator of non-financial performance for commercial banks. Zhao Ying and Liu Xinran argue that higher CSR engagement correlates with improved bank performance [5]. By fulfilling social responsibilities, banks can enhance their reputation and customer trust, thereby boosting profitability and competitive advantage. Concurrently, CSR initiatives help mitigate environmental and social risks, reduce non-performing loan ratios, and ensure sustainable development.

However, CSR commitments may also compel banks to allocate additional resources and capital to green credit projects, which could lower short-term profitability, elevate operational risks, and negatively impact performance. Against this dual backdrop, we propose:

Hypothesis 2: Corporate social responsibility strengthens the negative effect of green credit on the performance of China's listed commercial banks.

Study design:

Variable selection. The variables in this paper are divided into four types, namely explained variables, explanatory variables, control variables and moderating variables. The specific variable selection is shown in Table 1.

Table 1 – Variable Descriptions

| Variable Type | Variable Name | Variable Symbol | Calculation Method |
|---|---|---|---|
| Dependent Variable | Performance of Commercial Banks | BP | Factor analysis |
| Independent Variable | Green Credit Ratio | GC | Green credit balance / Total loan amount × 100% |
| Control Variables | Bank Size | lnSIZE | Natural logarithm of total assets at year-end |
| | GDP Growth Rate | GDPR | (Current year GDP − Previous year GDP) / Previous year GDP × 100% |
| | Proportion of Non-interest Income | NII | Non-interest income/Total income × 100% |
| | Net Profit Margin | NPM | Net profit / Sales revenue × 100% |
| | Debt-to-Asset Ratio | DAR | |
| Moderating Variable | Corporate Social Responsibility | CSR | Assign a value from 1 to 9 based on nine ESG rating levels from C to AAA |

Sample Selection. This study utilizes data from 16 listed commercial banks in China between 2011 and 2021, including:

5 state-owned banks: Bank of China, Agricultural Bank of China, Industrial and Commercial Bank of China, China Construction Bank, and Bank of Communications;

8 joint-stock banks: Industrial Bank, Shanghai Pudong Development Bank, Ping An Bank, China Minsheng Bank, China Merchants Bank, China CITIC Bank, China Everbright Bank, and Huaxia Bank;

3 city commercial banks: Bank of Beijing, Bank of Shanghai, and Bank of Ningbo.

Green credit data were collected from corporate social responsibility (CSR) reports and sustainability reports, while bank-level financial indicators were sourced from the Wind Database (a leading financial data provider in China). Macroeconomic data were obtained from the National Bureau of Statistics.

Performance Measurement of Commercial Banks Based on Factor Analysis. This study evaluates the performance of commercial banks using factor analysis, guided by China's 2021 Commercial Bank Performance Evaluation Guidelines. Nine secondary indicators across three dimensions were selected:

Development Quality: Economic Value Added (EVA), Net Profit per Employee, Profit Growth Rate

Risk Management: Non-Performing Loan (NPL) Ratio, Loan Loss Provision Coverage, Capital Adequacy Ratio

Operational Efficiency: Return on Equity (ROE), Return on Assets (ROA), Cost-to-Income Ratio

Data processing, feasibility tests (e.g., Kaiser-Meyer-Olkin test), factor extraction, and varimax rotation were conducted to derive component matrices. The final performance scores and rankings of the 16 listed banks were calculated based on weighted factor scores.

Model Specification. A short panel regression model was constructed as follows:

$$BP_{i,t}=\alpha_0+\beta_1 GC_{i,t}+\beta_2 \ln SIZE_{i,t}+\beta_3 GDPR_{i,t}+\beta_4 NII_{i,t}+\beta_5 NPM_{i,t}+\beta_6 DAR_{i,t}+\varepsilon_{i,t} \tag{1}$$

Where:

$BP_{i,t}$: Comprehensive performance score of bank $i$ in year $t$.

$GC_{i,t}$: Green credit ratio (independent variable).

Control variables:

$lnSIZE_{i,t}$: Natural logarithm of total assets.

$GDPG_{i,t}$: GDP growth rate.

$NII_{i,t}$: Non-interest income ratio.

$NPM_{i,t}$: Net profit margin.

$DAR_{i,t}$: Debt-to-asset ratio.

$\epsilon i,t$: Error term.

**Results**

The two-way fixed effects model regression results (Table 2) indicate that a 1-unit increase in the green credit ratio corresponds to a 3.87-unit decrease in commercial bank performance scores. This suggests that green credit initiatives exert a short-term negative impact on bank performance, consistent with the empirical findings of Sun Hongmei et al. [6].

Table 2 – Regression results

|  | Coefficient | Standard Deviation | t - value |
|---|---|---|---|
| GC | -3.870*** | 1.251 | -3.09 |
| lnSIZE | 0.954** | 0.348 | 2.74 |
| NII | -1.308* | 0.620 | -2.11 |
| GDPR | 20.560** | 7.545 | 2.72 |
| NPM | 8.552*** | 1.223 | 6.99 |
| DAR | -3.804 | 3.514 | -1.08 |
| _cons | -12.243** | 5.733 | -2.14 |
| Individual Effects | Controlled |  |  |
| Time Effects | Controlled |  |  |
| N | 176 |  |  |
| R2 | 0.798 |  |  |
| Notes: * p<0.1, ** p<0.05, *** p<0.01. | | | |

This study categorizes listed commercial banks into state-owned and non-state-owned groups based on ownership structure. As shown in Table 3, green credit exerts a statistically significant negative impact on the performance of non-state-owned commercial banks, whereas its effect on state-owned banks remains insignificant.

Table 3 – Heterogeneity Analysis Results

|  | State-owned Commercial Banks BP | Non-state-owned Commercial Banks BP |
|---|---|---|
| GC | -0.603 | -4.037*** |
|  | (1.814) | (1.126) |
| Control Variables | Yes | Yes |
| _cons | 5.167 | -18.680** |
|  | (3.944) | (8.133) |
| Notes: * p<0.1, ** p<0.05, *** p<0.01. | | |

This study measures corporate social responsibility (CSR) using Huazheng ESG ratings sourced from the Wind Database, following the data methodology of Xie Hongjun and Lv Xue [7]. Drawing on Hu Jie et al., ESG ratings (ranging from C to AAA) are assigned numerical scores from 1 to 9 [8].

The moderating effect model is specified as Equation (2), where $CSR_{i,t}$ represents the CSR score of commercial banks, and $GSR_{i,t}$ denotes the interaction term between CSR and green credit:

$$BP_{i,t}=\beta_0+\beta_1 GC_{i,t}+\beta_2 \ln SIZE_{i,t}+\beta_3 GDPR_{i,t}+\beta_4 NII_{i,t}+\beta_5 DAR_{i,t}+\beta_6 NPM_{i,t}+\beta_7 CSR_{i,t}+\beta_8 GSR_{i,t}+\epsilon_{i,t} \quad (2)$$

Denotes the interaction term between CSR and green credit:

As shown in Table 4, the coefficient of $GSR_{i,t}$ is -1.04 and statistically significant at the 5% level. Despite its modest magnitude, this result implies that, in the short term, CSR engagement exacerbates the negative impact of green credit on commercial bank performance.

Table 4 – Relationship Test of Corporate Social Responsibility, Green Credit, and Commercial Bank Performance

|  | BP |
| --- | --- |
| GC | -5.023*** |
|  | (0.986) |
| CSR | 0.028 |
|  | (0.019) |
| GSR | -1.040** |
|  | (0.383) |
| Control Variables | Yes |
| _cons | -1.669 |
|  | (2.500) |
| Notes: * p<0.1, ** p<0.05, *** p<0.01. | |

Robustness Tests
Inclusion of a Squared Term
To assess robustness, the baseline model is augmented by adding a squared term of the independent variable (green credit ratio), as specified in Equation (3):

$$BP_{i,t}=\beta_0+\beta_1 GC_{i,t}+\beta_2 \ln SIZE_{i,t}+\beta_3 GDPR_{i,t}+\beta_4 NII_{i,t}+\beta_5 NPM_{i,t}+B_6 DAR_{i,t}+\beta_7 GC^2_{i,t}+\epsilon_{i,t} \quad (3)$$

Regression results (Table 5) confirm the robustness of the original model. The statistically insignificant coefficient of the squared term ($\beta2$) rules out a U-shaped or inverted U-shaped relationship between green credit and bank performance.

Table 5 – Regression Results After Adding the Squared Term of the Explanatory Variable

|  | Post-Addition BP |
| --- | --- |
| GC | -1.458 |
|  | (2.168) |
| GC² | -7.378 |
|  | (4.496) |
| Control Variables | Yes |
| _cons | -12.713** |
|  | (5.647) |
| Notes: * p<0.1, ** p<0.05, *** p<0.01. | |

Substitution of the Explanatory Variable

To further validate robustness, this study replaces the green credit ratio with the logarithm of green credit balance as the explanatory variable. Results in Table 6 demonstrate that the core conclusions remain consistent, confirming the robustness of the findings.

Table 6 – Regression Results Before and After Variable Substitution (Full Sample)

|  | BP (Before Substitution) | BP (After Substitution) |
|---|---|---|
| GC | -3.376*** | — |
|  | (1.106) | — |
| lnGC | — | -0.166** |
|  | — | (0.075) |
| Control Variables | Yes | Yes |
| _cons | -5.043 | -15.585** |
|  | (5.728) | (5.940) |
| Individual FE | Yes | Yes |
| Time FE | Yes | Yes |
| N | 176 | 176 |
| R² | 0.828 | 0.786 |
| Notes: * p<0.1, ** p<0.05, *** p<0.01. | | |

**Discussion**

Establish Effective Incentives and Constraints to Enhance Banks' Green Credit Engagement. Effective incentives and constraints are critical drivers for green credit development. Governments can encourage banks to expand green credit through measures such as loan interest rate discounts and tax incentives. Concurrently, fiscal subsidies and tax benefits could be provided to enterprises meeting green credit criteria, reducing their financing costs and fostering green economic growth. Currently, China lacks binding constraints, leading many commercial banks to prioritize high-pollution and high-energy-consumption industries for profit maximization. To address this, governments should strengthen oversight of credit flows, impose penalties on banks excessively funding "high-pollution, high-energy-consumption, and overcapacity ('two highs and one surplus')" industries, and implement accountability mechanisms for non-compliant institutions.

Improve the Green Credit Policy Framework to Standardize and Promote Sustainable Finance.

◆ Legal and Regulatory Enhancements: Develop tailored laws and regulations to define the scope, evaluation criteria, and supervision requirements for green credit. Establish a standardized green credit evaluation system.

◆ Policy Support: Introduce supportive measures such as preferential loan rates and credit guarantees to incentivize financial institutions' participation in green credit.

◆ Regulatory Enforcement: Implement stringent penalties for violations and strengthen supervision mechanisms to ensure market standardization.

◆ Unified Information Disclosure System: Strengthen interdepartmental communication and build cross-bank information-sharing platforms.

Mandate corporate environmental impact disclosures to reduce information asymmetry and enable banks to assess environmental and social risks effectively. Enhance corporate oversight to ensure compliance with standards and disclosure requirements.

Establish Dedicated Green Credit Departments and Evaluation Mechanisms.To mitigate short-term performance challenges caused by underdeveloped evaluation systems, commercial banks should: Create dedicated green credit departments responsible for project assessment, management, and supervision. Develop comprehensive evaluation mechanisms (e.g., criteria, methodologies, and

procedures) to ensure thorough risk assessments, enhancing the sustainability and stability of green credit projects.

Innovate Green Credit Products and Services.

⬧ Current green credit offerings in China remain limited, primarily targeting traditional sectors like transportation and energy. To diversify:

⬧ Integrate sustainability as a core strategic priority in long-term planning.

⬧ Leverage fintech (e.g., big data, AI) to improve risk assessment capabilities and innovate green credit products.

⬧ Expand service coverage to emerging sectors such as renewable energy and circular economy.

Strengthen Talent Development for Green Credit. Professional expertise is vital to advancing green credit. Given the nascent stage of China's green finance sector:

⬧ Banks should prioritize capacity-building through internal and external recruitment and training programs.

⬧ Provide specialized training on green finance concepts and technical skills.

⬧ Collaborate with universities to develop green finance curricula and cultivate a talent pipeline for sustainable finance.

**Conclusions**

This study, based on an empirical analysis of 16 listed banks in China, explores the impact of green credit on the performance of commercial banks. As a key instrument for driving low-carbon economic transformation, the maturation of green credit business models and the optimization of institutional environments will gradually unlock its potential benefits. With the improvement of green financial policy frameworks, enhanced market awareness, and the application of technological innovations, green credit is expected to elevate commercial bank performance by optimizing asset structures, strengthening risk resilience, and fostering differentiated competitiveness. Although this study employs empirical methods to examine the impact of green credit on the operational performance of listed commercial banks in China and explores the moderating role of corporate social responsibility (CSR), several limitations remain. The sample is limited to 16 listed banks, which may not fully represent the broader banking sector, especially smaller city commercial banks and non-listed institutions. Additionally, since green credit is still in its early stages of development in China, with incomplete policies and institutional frameworks, the results primarily reflect short-term effects and may not capture the long-term benefits as the system matures. Furthermore, the green credit indicators used are constrained by the availability and consistency of public data, possibly failing to reflect the actual implementation quality. The heterogeneity of green credit–across industries, regions, and projects–also introduces complexity that could not be fully controlled in the model.

Therefore, China needs to accelerate the development of green credit incentive mechanisms, refine industry standards, and guide banks to strengthen the synergistic innovation between social responsibility and green business practices. These efforts aim to achieve sustainable development goals that balance ecological benefits with economic gains.

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## ҚЫТАЙДЫҢ БИРЖАДА ТІЗІЛГЕН КОММЕРЦИЯЛЫҚ БАНКТЕРІНІҢ ОПЕРАЦИЯЛЫҚ ТИІМДІЛІГІНЕ «ЖАСЫЛ НЕСИЕ» ӘСЕРІН ЭМПИРИКАЛЫҚ ТАЛДАУ

**Аңдатпа**

Қытайдың биржада тіркелген коммерциялық банктерінің қызметіне жасыл несиелеудің әсерін тереңірек зерттеу мақсатында бұл зерттеуде 16 банк таңдап алынды. Зерттеу Қытайдағы листингілік коммерциялық банктердің операциялық тиімділігіне жасыл несиенің ықпалын талдауға бағытталған. Банктердің қызмет көрсеткіштері факторлық талдау әдісі арқылы бағаланды, ал жасыл несиелеудің әсері тұрақты эффектілер және модераторлық модельдер арқылы зерттелді. Зерттеу нәтижелері Қытайда жасыл несиелеу саясатының салыстырмалы түрде жақында енгізілуі және институционалдық жүйенің толық қалыптаспауы себепті жасыл несиенің банктердің қызметіне теріс әсер ететінін көрсетті. Сонымен қатар, корпоративтік әлеуметтік жауапкершілік (КӘЖ) бұл теріс байланысты күшейтетін модераторлық рөл атқарады. Алайда ұзақ мерзімді перспективада жасыл несиелеуді дамыту – уақыт талабы мен қажеттілігіне сай бағыт. Жасыл несиелеу тетіктерінің үздіксіз жетілдірілуі банктердің қызметін жақсартып, Қытай үшін экологиялық және экономикалық тұрғыдан тиімді нәтижелерге қол жеткізуге мүмкіндік береді.

**Тірек сөздер:** жасыл қаржы, банк тиімділігі, факторлық талдау, ESG, жасыл несие.

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## ЭМПИРИЧЕСКИЙ АНАЛИЗ ВЛИЯНИЯ ЗЕЛЕНОГО КРЕДИТОВАНИЯ НА ОПЕРАЦИОННУЮ ЭФФЕКТИВНОСТЬ КИТАЙСКИХ КОММЕРЧЕСКИХ БАНКОВ, ПРЕДСТАВЛЕННЫХ НА БИРЖЕ

**Аннотация**

Для более глубокого изучения влияния зеленого кредитования на эффективность китайских коммерческих банков, котирующихся на бирже, в данном исследовании рассматриваются 16 таких банков в качестве объектов анализа. Целью исследования был анализ влияния зеленого кредитования на операционную эф-

фективность китайских коммерческих банков, акции которых котируются на бирже. Эффективность банков оценивалась с использованием факторного анализа, а влияние зеленого кредитования анализировалось с помощью моделей фиксированных эффектов и модерации. Результаты показали, что из-за относительно короткого срока реализации политики зеленого кредитования и несовершенства институциональных механизмов в Китае зеленое кредитование в настоящее время отрицательно связано с показателями эффективности банков. Кроме того, корпоративная социальная ответственность (КСО) оказывает усиливающее модерационное воздействие на это негативное влияние. Тем не менее в долгосрочной перспективе развитие зеленого кредитования является неизбежным трендом. Постепенное совершенствование механизмов зеленого кредитования приведет к повышению эффективности банков и обеспечит экологические и экономические выгоды для Китая.

**Ключевые слова:** зеленая финансовая система, эффективность банков, факторный анализ, ESG, зеленое кредитование.

Article submission date: 25.04.2025