

Green Credit Policy and the Debt Scale of Heavily Polluting Enterprises Evaluation of the Mediating Effect Based on Corporate ESG Performance

Zhenhe Lin^{1,a,*}

¹Research Institute of Economics and Management, Southwestern University of Finance and Economics, Chengdu, China

a. 42140014@smail.swufe.edu.cn

**corresponding author*

Abstract: With the gradual development of low-carbon and environmental actions, the implementation of policies such as green credit has been effective. Based on the dataset of A-share listed companies spanning from 2009 to 2023, this paper focuses on the relationship between green credit policies and the debt scale of heavily polluting enterprises, and explores the role of ESG performance in this relationship through the evaluation of intermediary effects. To facilitate identification, we used the parallel trend test, dividing the data before and after the policy publication into two groups. This is more conducive to observing the effects and effects of policies. The findings indicate a clear suppression of the debt scale among heavily polluting enterprises following the enactment of relevant policies in 2012, highlighting the discernible impact of these policies. Finally, the enlightenment and suggestions are put forward based on the conclusion.

Keywords: green credit policy, ESG, heavily polluting enterprises, scale of debt

1. Introduction

The rapid pace of urbanization and industrialization in China has brought to the forefront the pressing issue of environmental pollution. In response, the country has prioritized environmental protection as a fundamental aspect of its economic development strategy. Embracing a path of low-carbon, environmentally friendly, and energy-efficient growth is deemed essential for sustainable economic progress. The advancement of the green economy plays a pivotal role in shaping corporate financing dynamics, particularly for industries with high pollution levels. They often face significant adjustment costs and substantial financing requirements, underscoring the necessity for ample financial support to facilitate their transition towards sustainable development practices.

Green credit is an instrumental driver for fostering sustainable development and safeguarding the environment. China has long acknowledged the importance of green credit, as evidenced by the establishment of the Green Credit Guidelines by the China Banking Regulatory Commission (CBRC) in 2012. According to the guidelines, banks are required to factor in environmental risks when assessing loan applications from companies. For enterprises deemed to carry higher environmental risks, the guidelines prescribe a range of measures. These measures include stringent control over capital inflows, imposition of punitive interest rates, loan suspensions, or early loan recovery. By

imposing financial constraints, the aim of this policy is to curtail the expansion of production activities by high-polluting and high-emission industries, thereby propelling their transition towards greener practices.

2. Literature Review

Green credit, as a important component of the green financial system, fundamentally operates on the principles of green-oriented credit rationing policy. Scholars have conducted varied levels of research surrounding the efficacy and implementation impact of green credit policies.

According to Ning and Shen [1], the enactment of green credit policies has markedly boosted the inclination of manufacturing enterprises towards green transformation by intensifying their financing constraints. Moreover, the collaboration between the government and enterprises is crucial in amplifying the innovation incentives resulting from green credit policies, leading to a notable positive moderating impact. According to Zhang and Dong [2], the introduction of green credit policies has had a substantial positive impact on the advancement of green technology innovation within enterprises. Correspondingly, Dong and Pan [3] have also corroborated the positive and significant effect of green credit policies on the capital adjustment of high-polluting enterprises.

A review of the literature shows that corporate debt financing has also attracted extensive attention in the academic community. Among them, in terms of corporate financial characteristics, Denis et al. [4] studied from the perspectives of corporate profitability, growth, operational risk and financial leverage. Through the utilization of the dual difference method, Su and Lian [5] discovered that the green credit policy imposes a penalizing effect on interest-bearing debt financing and long-term liabilities of heavily polluting enterprises. This impact is particularly pronounced among state-owned business, large corporations, and those situated in regions characterized by high pollution emissions. Furthermore, Zhong et al. [6] employed the dual difference model to analyze the impact of green credit policy. Their micro-level analysis revealed a significant increase in the debt financing costs for highly polluting enterprises due to the policy.

What is the actual impact of the green credit policy? Has it effectively reduced the anticipated debt levels of high-polluting enterprises? Furthermore, could corporate ESG performance potentially mediate the underlying influence mechanism?

To investigate the impact of green credit policies on the debt financing scale, this study utilizes a sample of China's A-share listed companies spanning from 2009 to 2023. It builds upon the quasi-natural experiments conducted by previous researchers on green credit policies and focuses on the enactment of the Green Credit Guidelines as a significant policy milestone. By employing the difference-in-difference model (DID) and conducting various analyses such as propensity score matching and parallel trend testing, the study aims to evaluate the effectiveness of green credit policies in influencing the debt financing scale. Additionally, this research goes a step further by introducing corporate ESG performance as a mediating variable, to gain deeper insights into the underlying mechanisms.

This paper makes several contributions. Firstly, it applies the propensity score matching method in addition to the DID model, addressing the endogeneity issue and potential bias caused by self-selection of samples. This approach ensures a more scientific and rigorous evaluation of the effects of past policies. Additionally, the findings serve as a reliable reference for enhancing future green credit policies.

Second, from the perspective of corporate ESG performance, by considering both internal and external factors that influence enterprises, this study investigates the transmission mechanism of the green credit policy on the debt scale of high-polluting enterprises. Furthermore, it analyzes the mediating role of corporate ESG performance in bridging the relationship between the green credit policy and the debt scale of these enterprises. Through empirical analysis, this study provides valuable

evidence that clarifies the pathway through which the green credit policy and ESG performance impact the debt scale.

3. Hypothesis Development

The implementation of green credit policies has effectively restrained the magnitude of debt financing for heavily polluting companies from both supply and demand perspectives. From the supply side, adherence to green credit policy mandates by banks, such as imposing credit restrictions on heavily polluting enterprises, denying credit to firms failing to meet environmental standards, and suspending funding allocation for environmentally risky projects, results in a diminished scale of debt financing for these enterprises. In addition, the policy requires companies to disclose information about the existence of major environmental risks in their green credit business, which increases the reputational risk and may face public opinion pressure and environmental lawsuits, making external creditors more cautious in providing funds.

On the demand side, the financing environment for heavily polluting enterprises has become more severe under the influence of supply dynamics. With the incorporation of green credit policies, these companies will make more prudent decisions to expand the scale of debt. Simultaneously, the policy shows the government's determination to environmental governance, prompting heavily polluting enterprises to consider adjusting their production methods, reducing capital investment in high-polluting and high-emission projects, and diminishing the demand for funds. As a result, the following hypotheses are posited:

H1: The enforcement of the green credit policy has effectively curtailed the debt scale of heavily polluting enterprises.

At present, when banking institutions carry out green credit business, they need to strictly review the loan applications of high-polluting projects and allocate corresponding credit funds according to the environmental performance, so green credit policies can help guide banking institutions to care more about the ESG performance of highly polluting enterprises. Building upon signaling theory, Wu et al. [7] discovered a close association between the provision of green credit by banking institutions and a company's commitment to environmental responsibility. This linkage encourages high-polluting enterprises to actively unveil social responsibility information, thereby alleviating the constraints of green credit. Yang [8], through empirical research, demonstrates that the implementation of green credit policies contributes significantly to the enhancement of corporate ESG performance.

When exhibiting superior ESG performance, companies are more inclined to receive backing from green credit policies, thereby experiencing more lenient financing terms. ESG factors play a key role in banks' trust in financing decisions. Banks may be more willing to provide financing to companies with good ESG performance. The following hypotheses are proposed:

H2: Corporate ESG performance plays a positive mediating effect between green credit policies and the scale of heavily polluting corporate debt.

4. Research Design

4.1. Sample Selection and Variable Description

This research takes China A-share listed companies from 2009 to 2023 as the total sample of the study, referring to the "Industry Classification Guidelines for Listed Companies" issued by the China Securities Regulatory Commission in 2012, constructs the experimental group and counterfactual reference group according to the pollution level. Referring to existing research, this paper excludes samples with serious deficiencies in financial data such as financial companies, STs, etc. In addition, this paper uses the balanced panel data, and finally obtains 85,635 observations after data processing,

and 75,558 observations are obtained after matching the ESG scores of enterprises in the mediating effect test. The data required for the empirical part are all from CSMAR and processed using EXCEL, Python and Stata18.

Table 1: Variable Definition

	Variable	Symbol	Description
Dependent	Scale of debts	Abank	The sum of long-term and short-term borrowing / total assets
Independent	Policy dummy	time	Before 2012, time=0; In 2012 and later, time=1
	Group dummy	treat	For heavy polluting enterprises, treat=1; otherwise, treat=0;
	Doubled-difference	treat×time	Only in 2012 and later DID = 1, the rest is 0
Control	Profitability	ROA	Net income / total assets
	Debt repayment level	Cash	Net cash flow from operating activities / current liabilities
	Company size	Size	Natural logarithm of total assets
	Growth	Growth	[(Operating income) _t - (operating income) _{t-1}] / (operating income) _{t-1}
	Mortgage ability	Mortgage	Natural logarithm of the net fixed assets
Mediating	ESG performance	ESG	China Securities Index ESG score

Dependent variable: The debts of enterprises mainly include funds raised through bank credit, commercial credit, bond issuance and other ways. At present, there are few financing channels for Chinese enterprises, with bank loans being the primary source of funding. Consequently, the green credit policy holds significant influence over the loan financing of enterprises. According to Chen and Zhang [9], the index to measure the debt scale is mainly borrowing, specifically the ratio of the total short-term and long-term borrowings to total assets (Abank).

Independent variable: Set up the policy virtual variables (time) and the group virtual variables (treat). Among them, before 2012, without policy impact, time=0; 2012 and later, time= 1; heavy pollution enterprises for the experimental group, treat = 1, other enterprises, treat = 0. The core independent variable in this study is the interaction term between the policy virtual variable (time) and the group virtual variable (treat), denoted as time×treat. The coefficient of this term quantifies the net impact of the green credit policy on the scale of debt.

4.2. Methodology

This paper first use PSM to screen individual enterprises that are not subject to green credit policies and heavy polluting enterprises in the same period. The unmatched samples were removed and DID regression was performed with the matched samples, and the regression model was as follows:

$$Abank_{it} = \beta_0 + \beta_1 treat_i + \beta_2 time_t + \beta_3 treat \times time + \beta_3 \sum control + Company + Year + \theta_{it} (1)$$

where i is the enterprise; t is time; *control* is the control variable; *Company* and *Year* control fixed effects; β_3 reflects the impact of green credit policy on the debt scale.

5. Empirical Results

5.1. Descriptive Statistics

Table 2 presents descriptive statistics of the key variables. Notably, the result reveals that the mean value of the difference-in-difference (DID) is 0.281, suggesting that approximately 28% of the companies in the sample have been influenced by the policy. It is worth mentioning that both the dependent and independent variables exhibit a variance of less than 1, indicating minimal variation among the samples and robustness.

Table 2: Descriptive Statistics

	Variable	N	Mean	Std. dev.	Median	Min	Max
Dependent	Abank	85635	0.208	0.132	0.192	0.000	3.685
Independent	time	85635	0.888	0.316	1.000	0.000	1.000
	treat	85635	0.323	0.468	0.000	0.000	1.000
	treat×time	85635	0.281	0.449	0.000	0.000	1.000
Control	ROA	85635	0.180	0.057	0.015	-6.776	2.312
	Cash	85635	0.595	0.225	0.032	-10.170	7.283
	Size	85635	22.725	1.373	22.544	18.108	28.679
	Growth	85635	0.599	12.862	0.468	-1.000	3205.955
	Mortgage	85635	20.868	1.711	20.746	11.925	27.320
Mediating	ESG	75558	73.023	5.536	73.250	38.920	91.460

5.2. Correlation Analysis and Multicollinearity Test

Before performing regression analysis, a test of the correlation coefficient matrix is required. Table 3 presents the results which demonstrate a significant positive correlation between the main explanatory variable and the size of debt, aligning with the anticipated assumptions. The possibility of variable collinear can also be preliminarily ruled out because the absolute value does not exceed 0.9. The correlation between Growth and other variables in the control variables is poor, which will be gradually reflected in the subsequent empirical analysis.

To avoid potential collinearity issues, it is necessary to carry out the multicollinearity test. The variance expansion factor (VIF) is utilized to examine the presence of multicollinearity. As illustrated in Table 4, all variables have VIF values below 10. Thus, overall, the selected indices in this study exhibit no collinearity concerns.

Table 3: Correlation Test

	Abank	treat×time	ROA	Cash	Size	Growth	Mortgage	ESG
Abank	1.000							
treat×time	0.105***	1.000						
ROA	-0.231***	0.037***	1.000					
Cash	-0.082***	0.120***	0.269***	1.000				
Size	0.085***	0.085***	0.038***	0.069***	1.000			
Growth	0.001	-0.006	0.006	0.004	0.015***	1.000		
Mortgage	0.163***	0.274***	0.040***	0.202***	0.746***	0.002	1.000	
ESG	-0.117***	-0.006	0.141***	0.048***	0.269***	-0.009	0.161***	1.000

Table 4: Multicollinearity Test

	Variable	VIF	1/VIF
Independent	time	1.630	0.615
	treat	7.860	0.127
	treat×time	8.130	0.123
Control	ROA	1.110	0.903
	Cash	1.160	0.865
	Size	2.550	0.392
	Growth	1.000	0.999
	Mortgage	2.700	0.371
	ESG	1.100	0.906
Mediating	Mean VIF	3.030	

5.3. Propensity Score Matching (PSM), Equilibrium Test and Parallel Trend Test

In this research, the propensity scores of all samples are matched year-by-year. To validate the accuracy of the matching outcomes, an equilibrium test was conducted on the matched samples.

Table 5 presents the results of the equilibrium test conducted in this study. After performing propensity score matching, the standard deviation of all variables, except for Growth, substantially decreased. Notably, ROA, Cash, and Mortgage exhibited reductions of over 80%. This implies that while sacrificing Growth, the standard deviation of control variables can still be effectively reduced across the entire sample, ensuring a high degree of similarity between the constructed counterfactual control group and the experimental group in all aspects.

It can be seen that after propensity score matching, the %bias of all covariates is below 10%, except for Growth. The %bias of other covariates is significantly smaller, with substantially lower absolute values. The effect of propensity score matching passed the equilibrium test.

Figure 1 aligns with the findings presented in Table 5, i.e., the %bias of all covariates is less than 10%, except for Growth, which is significantly smaller than the pre-match %bias.

The results of the parallel trend test on the PSM-matched sample are depicted on the right side of Figure 1. "Current" indicates that the time of the issuance of the "Guidelines" is 2012 as the impact point. The first year of the sample data (2009) is used as the base period. The interaction term coefficients of the DID in the time period before 2012 are not statistically significant. This implies that there were no significant differences observed between two groups prior to the policy shock. With parallel trend checking, regression can be performed using DID model. At the same time, the interaction term coefficient of DID begins to be significant after the policy is released, indicating that the hypothesis H1 is true.

Table 5: Equilibrium Test

Variable	Unmatched(U) /matched(M)	%bias	%Reduct bias	T-test	
				t	P> t
ROA	U	10.1		13.53	0.000
	M	-0.2	97.7	-0.32	0.750
Cash	U	27.3		37.52	0.000
	M	-3.5	87	-4.00	0.000
Size	U	13.7		18.74	0.000
	M	4.4	67.9	5.12	0.000
Growth	U	-0.4		-0.45	0.651
	M	-0.3	6.6	-0.31	0.760
Mortgage	U	63.8		87.15	0.000
	M	3.3	94.8	3.99	0.000

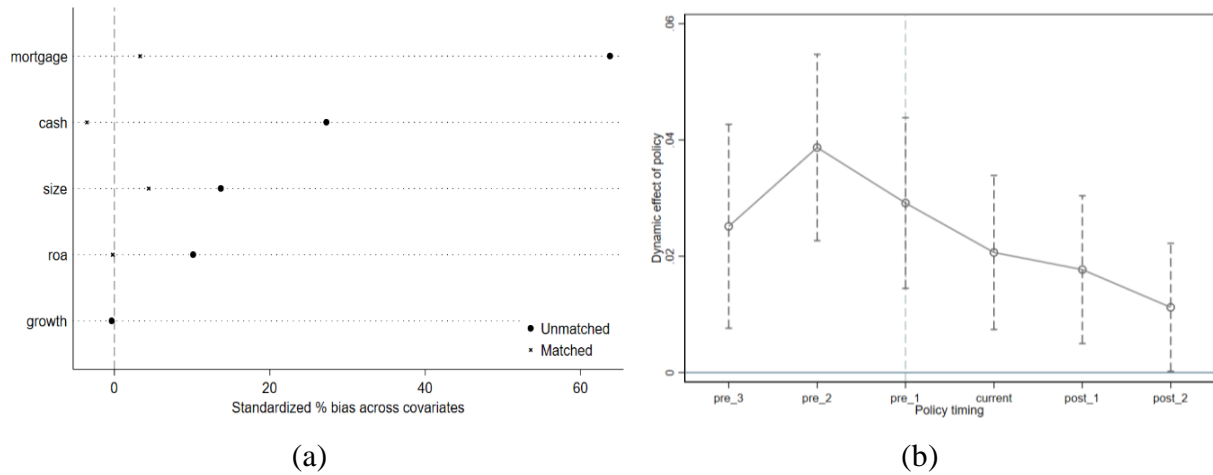


Figure 1: Propensity Score Matching and Parallel Trend Test

5.4. Benchmark Regression Results

The impact of green credit policies on corporate green innovation is illustrated in Table 6. In Column (1), regression results without control variables reveal negative coefficients for $treat \times time$, suggesting a detrimental effect of the policy on the debt scale. Upon inclusion of control variables in Column (2), the coefficient of $treat \times time$ significantly shifts to a positive value at a significance level of 1%. This indicates that the policy has indeed played a "reversing" role in the debt scale, aligning with the hypothesis H1. The adjusted R-squared also increased from 0.045 to 0.127, indicating that the

addition of control variables made an incremental contribution to the equation fitting. The control variables other than growth have shown a significant effect on the debt scale.

Table 6: Benchmark Regression Results

Variable	Abank	
	(1)	(2)
treat×time	-0.032*** (-11.00)	-0.026*** (-9.49)
time	-0.041*** (-23.18)	-0.051*** (-30.14)
treat	0.073*** (27.05)	0.060*** (22.95)
ROA		-0.535*** (-69.12)
Cash		-0.041*** (-20.57)
Size		-0.002*** (-4.56)
Growth		0.000 (0.31)
Mortgage		0.014*** (33.28)
Constant	0.230*** (137.75)	0.022*** (3.14)
Company	YES	YES
Year	YES	YES
Observations	85635	85635
Adj.R ²	0.045	0.127

Note: * indicates $P < 0.1$, ** $P < 0.05$, *** $P < 0.01$; The t-values are shown in parentheses.

5.5. The Mediating Effect

Building upon the theoretical framework discussed above, this paper introduces corporate Environmental, Social, and Governance (ESG) performance as a mediating variable to investigate the influence of green credit on the debt scale of heavily polluting enterprises. The findings regarding the mediating effect of corporate ESG performance are presented in Table 7.

After the process of ESG data matching and null value sample screening, 75,558 observations were finally obtained. To determine whether the mediation effect is valid, the main judgment is whether the confidence interval contains 0. For the mediating effect, the confidence interval is (0.0003, 0.0008) without 0, indicating that the mediating effect is valid and significant at the 99% level. The direct effect analysis revealed a confidence interval of (0.0188, 0.0229) without encompassing 0, indicating that the independent variable (treat×time) significantly influenced the dependent variable (Abank) at the 99% confidence level. The results align with hypothesis H2.

Table 7: Mediating Effect Test

Effect	Obs	Coef.	Boot std. dev.	Boot CI [95% conf. interval]	
Mediating effect	75558	0.001***	0.000	0.0003	0.0008
Direct effect	75558	0.021***	0.001	0.0188	0.0229

Note: * means $P < 0.1$, ** means $P < 0.05$, and *** means $P < 0.01$;

5.6. Robustness Test

The robustness test also uses the DID regression method. As shown in Table 8, the core regression coefficient is still significantly positive at the 1% level. Furthermore, the matching results do not reveal any substantial differences, indicating that the empirical findings are robust.

Table 8: Robustness Test

Variable	Abank	
	(1)	(2)
treat×time	0.031*** (30.90)	0.020*** (19.45)
ROA		-0.513*** (-65.04)
Cash		-0.042*** (-20.35)
Size		-0.007*** (-14.58)
Growth		0.000 (1.109)
Mortgage		0.017*** (42.23)
Constant	0.200*** (377.12)	0.016** (2.23)
Company	YES	YES
Year	YES	YES
Observations	85635	85635
R-squared	0.01	0.09

Note: Those in parentheses are the t-statistic values; *, ** and *** are significant at 10%, 5% and 1% levels, respectively.

6. Conclusion

The empirical findings demonstrate that the implementation of green credit policies has a notable restraining effect on the debt scale of heavily polluting enterprises. Moreover, these policies are

associated with a significant enhancement in the ESG performance of heavily polluting companies. Furthermore, it is observed that ESG performance serves as a substantial mediator in the aforementioned relationship, exerting additional control over the debt scale.

After the correlation test, multicollinearity test, PSM and so on, the empirical findings consistently confirm the conclusion that the green credit policies significantly curbs the debt scale. Additionally, several control variables, such as profitability, debt service level, enterprise size, and mortgage capacity help to suppress the debt scale, while the growth impact is not correlated.

Based on the research findings, the following insights emerge.

First, commercial banks and financial institutions must maintain rigorous control over credit thresholds. Regulatory authorities should enhance and fine-tune the oversight standards pertaining to green credit policies, and encourage banks and governments to consciously and proactively implement green credit policies.

Second, enterprises should prioritize the dissemination of information and bolster corporate governance through media channels. This initiative aims to enhance stakeholders' understanding of the enterprise, thereby augmenting the transparency of corporate information. Enterprises should more actively disclose environmental information, which can mitigate information asymmetry between themselves and stakeholders. This transparency, facilitated through media reports, can help build trust among stakeholders.

References

- [1] Ning, Y.X. & Shen, B. (2023). *Research on the influence of the green credit policy on the green innovation of enterprises: Based on the relationship between government and business [J]. Journal of Xi'an Petroleum University (Social science edition)*, 32 (06): 1-7.
- [2] Zhang, H.Y. & Dong, X.H. (2023). *Research on the influence of green credit policy on green and low-carbon technology progress under the goal of "double-carbon". Shanghai Energy Saving (11)*, 1605-1614.
- [3] Dong, Y. & Pan, H.Y. (2023). *Green credit policy, ESG performance and the capital structure adjustment of highly polluting enterprises. Resources and Industry*, 1-11.
- [4] Denis D J & McKeon S B. (2012). *Debt Financing and Financial Flexibility Evidence from Proactive Leverage Increases [J]. The Review of Financial Studies*, 25 (6), 1897-1929.
- [5] Su, D.W. & Lian, L.L. (2018). *Does green credit affect the investment and financing behavior of heavily polluting enterprises? Financial research (12)*, 123-137.
- [6] Zhong, X.B., Ma, F.C., Wei, Y., Xie, W.Y. & Li, B.R. (2022). *How does the green credit policy affect the corporate debt financing cost: On the question of the existence of a "carbon bubble". Finance and Economy (09)*, 86-96.
- [7] Wu, H.J., Liu, Q.R. & Wu, S.N. (2017). *Company environmental protection information disclosure and financing constraints. World Economy (05)*, 124-147.
- [8] Yang, Q. (2022). *Green credit and corporate ESG performance: Empirical evidence from Chinese A-share non-financial listed companies. Financial Development Reviews (12)*, 26-39.
- [9] Chen Q., & Zhang G.Y. (2019). *Study on the influence of green Credit on corporate debt financing: Experiential data from heavily polluting companies[J]. Accounting Communication (8)*, 36-40.