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A Study on the Impact of ESG Performance on Debt Financing Costs: Based on the Moderating Effect of Green Credit Policies

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Abstract: This study empirically examines the impact of corporate ESG performance on debt financing costs using a sample of non-financial listed companies on China's A-share market from 2009 to 2024, with a particular focus on the moderating effect of the 2012 Green Credit Guidelines implementation. The findings reveal: (1) Strong ESG performance significantly reduces corporate debt financing costs, a conclusion that remains robust after a series of stability tests and addressing endogeneity issues. (2) Green credit policies mitigate the debt cost-saving effect of ESG performance. (3) Heterogeneity analysis indicates that this policy moderation effect is more pronounced among non-state-owned enterprises and companies in western China. This study not only provides direct financial incentive evidence for companies to actively pursue ESG strategies but also offers decision-making references for regulators to further refine green finance policy frameworks and implement differentiated guidance.

Keywords: ESG; Debt financing costs; Green credit policies; Difference-in-differences method; Moderation effects

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1. Introduction

In recent years, as the concept of global sustainable development has gained deeper traction, environmental, social, and governance (ESG) performance has emerged as a core dimension of corporate non-financial performance. It plays a vital role in signaling and risk management within capital markets. Concurrently, China is actively building a green financial system. The Green Credit Guidelines issued by the former China Banking Regulatory Commission in 2012 stand as a landmark policy, aiming to channel credit resources toward green and low-carbon sectors and drive corporate green transformation. Against this backdrop, how corporate ESG performance influences debt financing costs, and whether and how green credit policies mediate this relationship, has emerged as a critical issue with both theoretical and practical significance.

Existing research predominantly focuses on the unidirectional impact of ESG on capital costs, lacking

systematic examination of the interaction between external institutional environments and internal non-financial performance, particularly lacking causal evidence based on policy shocks. Therefore, this paper uses Chinese listed companies as a sample to deeply explore the mechanism through which ESG performance affects debt financing costs and empirically tests the moderating effect of green credit policies, aiming to provide references for improving green finance policies and guiding corporate ESG practices. This study holds multifaceted significance. Theoretically, by constructing an interactive analytical framework linking ESG and green credit policies, it expands the research frontiers on how corporate non-financial performance influences debt financing costs, fostering the integration of institutional theory and signaling theory within the green finance domain. At the policy level, the findings provide a basis for evaluating the effectiveness of green credit policies, optimizing policy tools, and implementing differentiated management approaches. Practically, it not only reveals the financial incentives for ESG development but also offers guidance for financial institutions in credit risk assessment and lending decisions, thereby supporting the green transformation of the real economy.

2. Theoretical analysis and research hypotheses

Based on signaling theory, ESG performance, as a key indicator of non-financial corporate performance, can convey positive signals to capital markets regarding a company's sustainable development capabilities, risk management proficiency, and long-term operational stability. This mitigates information asymmetry between creditors and corporations, thereby lowering risk premiums in debt financing processes [1]. Simultaneously, stakeholder theory suggests that strong ESG practices enable systematic management of multidimensional risks, environmental, social, and governance, thereby enhancing stakeholder trust, reducing potential compliance costs and operational uncertainties, and ultimately lowering overall corporate risk levels and financing costs [2–4]. Based on this, we propose the first hypothesis:

H1: Better corporate ESG performance correlates with lower debt financing costs.

According to institutional theory, external policy environments alter corporate behavioral logic and the effectiveness of market signals. The implementation of the 2012 Green Credit Guidelines marked a shift from voluntary environmental initiatives to mandatory constraints, causing banks' credit decision-making criteria to transition from market signal discernment to policy compliance review. Following this policy, high-environmental-risk firms generally increased ESG investments to meet compliance requirements, leading to convergence in ESG performance within industries and diminishing its role as a differentiating signal [5]. Simultaneously, financial institutions increasingly allocated credit based on green credit catalogs and rigid environmental compliance metrics, directly raising debt financing costs for high-risk firms and reducing the marginal contribution of ESG performance to debt pricing [6]. Based on this, we propose the second hypothesis:

H2: The implementation of green credit policies significantly weakens the cost-reducing effect of corporate ESG performance on debt financing costs.

From an integrated perspective of resource dependence theory, institutional theory, and signaling theory, corporate sensitivity to external policy environments and the market signaling value of their ESG performance

exhibit systematic differences across varying property rights structures and regional contexts. Non-state-owned enterprises typically face stronger financing constraints and weaker political connections, making their credit access more reliant on market signals and policy compliance performance. Consequently, green credit policies exert a more pronounced moderating effect on their ESG financing outcomes [7]. Western regions exhibit relatively lower financial marketization and stronger policy enforcement, leading enterprises to rely more heavily on policy guidance for resource acquisition. Consequently, firms in these areas demonstrate more pronounced responses to green credit policies. Based on this, we propose a third hypothesis:

H3: The moderating effect of green credit policies on the relationship between ESG performance and debt financing costs is more pronounced among non-state-owned enterprises and enterprises in western regions.

3. Research design

3.1. Sample selection and data sources

This study uses non-financial listed companies on China's A-share market from 2009 to 2024 as its sample. Data processing procedures include as follows:

(1) Excluding abnormal operational samples such as ST, *ST, and PT stocks;

(2) Excluding financial industry enterprises;

(3) Removing samples with missing variables;

(4) Eliminating single-observation samples for individual companies within the sample period;

(5) Truncated continuous variables at the 1–99% range.

After data processing, 40,462 observations from 4,377 listed companies were obtained. The ESG scores for enterprises in this paper are derived from the Huazheng ESG Rating System. Debt financing costs and corporate financial data are sourced from the CSMAR database. Data on the proportion of environmental protection project loans are compiled from authoritative websites such as the National Bureau of Statistics, the Ministry of Science and Technology, the People's Bank of China, and various authoritative statistical yearbooks.

3.2. Variable definitions

3.2.1. Dependent variable

Cost of Debt Financing (*COD*) is measured by the ratio of total interest expenses plus handling fees and other financial charges to total liabilities at the end of the period, following the methodology of Zheng *et al.* (2013) [8].

3.2.2. Independent variables

The core explanatory variable is the firm's ESG composite score (*ESG*), measured using the Huazheng ESG Rating system. This score is assigned values from 1 to 9 across nine tiers (C to AAA), with higher scores indicating better ESG performance. To capture the heterogeneous effects of green credit policies, this study adopts the instrumental variable approach proposed by Meng *et al.* (2025), creating a green credit policy dummy variable (*Post*×*Treat*) [9]. It takes a value of 1 if the sample belongs to a green credit-restricted industry and the observed year is during or after the policy implementation year, and 0 otherwise. The green credit-restricted industries comprise nine sectors: nuclear power generation, hydropower generation, water conservancy and inland port construction, coal mining and washing, petroleum and natural gas extraction, ferrous metal mining and beneficiation, non-ferrous metal mining and beneficiation, non-metallic mineral mining and beneficiation, and other mining industries.

3.2.3. Moderator variable

The moderator variable is the intensity of regional green credit policies (*Policy*), measured by the proportion of total environmental protection project loans to total loans in each province to reflect the quantitative rigor of policy implementation.

3.2.4. Control variables

This study incorporates a series of control variables to account for other potential influencing factors, primarily including as follows:

(1) Firm size (*Size*), measured by the natural logarithm of annual total assets;
(2) Debt-to-asset ratio (*Lev*), measured by the ratio of year-end total liabilities to year-end total assets;
(3) Inventory ratio (*INV*), measured by the ratio of net inventory to total assets;
(4) Return on Assets (*ROA*), measured as the ratio of net profit to the average balance of total assets;
(5) Cash Flow Ratio (*Cashflow*), measured as the ratio of net cash flow from operating activities to total assets;
(6) Revenue Growth Rate (*Growth*), measured as the difference between current-year and prior-year revenues divided by prior-year revenue;
(7) Top Ten Shareholder Ownership Ratio *(Top10*), measured as the proportion of shares held by the top ten shareholders relative to total shares outstanding;
(8) Tobin's Q ratio (*TobinQ*), measured by dividing the sum of the valuation (calculated as the market value of circulating shares plus the book value of non-circulating shares multiplied by net asset value per share) and the book value of liabilities by the company's total assets;
(9) Listing Age (*ListAge*), measured by taking the logarithm of the result obtained by subtracting the year of listing from the current year and adding 1.

3.3. Empirical model

Based on the research content of this paper, the empirical analysis model is constructed as follows.

3.3.1. Main effects model (H1)

$$COD_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\alpha_j Control_{j,i,t}+\lambda_i+year_t+\varepsilon_{i,t} \quad (1)$$

3.3.2. Moderated effect model (H2)

$$COD_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\alpha_2 ESG\times Policy_{i,t}+\alpha_3 Policy_{,i,t}+\alpha_j Control_{j,i,t}+\lambda_i+year_t+\varepsilon_{i,t} \quad (2)$$

3.3.3. Difference-in-differences (DID) model to validate policy impact

$$COD_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\alpha_2 Post_t\times Treat_i\times ESG_{i,t}+\alpha_3 Post_t\times Treat_i+\alpha_j Control_{j,i,t}+\lambda_i+year_t+\varepsilon_{i,t} \quad (3)$$

where i,t denotes data for firm i in year t, α_0 is the intercept, α_j represents variable coefficients, λ_i is the individual fixed effect, $year_t$ is the time fixed effect, $\varepsilon_{i,t}$ is the random disturbance term, and $ESG\times Policy_{i,t}$ is the

interaction term between the explanatory variable and the moderator variable.

4. Empirical results analysis

4.1. Descriptive statistics

Descriptive statistical analysis was conducted on each variable selected for this study. The results are presented in **Table 1**.

Table 1. Descriptive statistics

VarName	Obs	Mean	SD	Min	Max
COD	40462	0.019	0.014	0.000	0.061
ESG	40462	4.111	1.109	1.000	7.000
Post×Treat	40462	0.017	0.129	0.000	1.000
KZ	40462	1.303	2.491	-11.417	13.663
Policy	40462	0.035	0.013	0.005	0.054
Size	40462	22.355	1.300	19.959	26.394
Lev	40462	0.442	0.203	0.063	0.911
INV	40462	0.141	0.129	0.000	0.687
ROA	40462	0.029	0.065	-0.258	0.192
Cashflow	40462	0.054	0.077	-0.171	0.291
Growth	40462	0.132	0.359	-0.568	2.062
Top10	40462	0.561	0.153	0.219	0.899
TobinQ	40462	2.038	1.299	0.825	8.379
ListAge	40462	2.344	0.670	1.099	3.434

As shown in **Table 1**, the mean value of COD is 0.019 with a standard deviation of 0.014. This indicates that the overall cost of debt financing for the sample enterprises is at a relatively low level, with limited variation among different companies. The mean ESG composite score is 4.111 with a standard deviation of 1.109, reflecting that the ESG performance of the sample companies is concentrated at a lower-middle level, while also exhibiting certain differences and distinctiveness among different enterprises.

4.2. Benchmark regression

Based on the benchmark regression model constructed in this paper, regression analysis was conducted, with the results shown in **Table 2**.

Table 2. Benchmark regression

VarName	(1) COD	(2) COD	(3) COD
ESG	-0.000826***	-0.000561***	-0.000541***
	(-14.11)	(-9.84)	(-9.55)
Size		0.000675***	0.0000613
		(5.52)	(0.46)
Lev		0.0201***	0.0189***
		(38.33)	(35.64)
INV		-0.0128***	-0.0134***
		(-15.60)	(-16.39)
ROA		-0.0231***	-0.0201***
		(-21.06)	(-18.20)
Cashflow		0.00892***	0.00896***
		(11.13)	(11.22)
Growth		-0.00190***	-0.00167***
		(-13.07)	(-11.46)
Top10			-0.00309***
			(-4.29)
TobinQ			-0.000667***
			(-10.72)
ListAge			0.00496***
			(15.59)
_cons	0.0219***	-0.000854	0.00475*
	(89.39)	(-0.32)	(1.67)
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	40462	40462	40462
F	199***	541***	430***
r2	0.600	0.636	0.641
r2_a	0.551	0.592	0.597

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Column (1) in **Table 2** presents the regression results without control variables. Column (2) shows the results with corporate financial indicators as control variables, while Column (3) displays the results with all control variables included. All three columns indicate that corporate ESG performance exerts a significant negative impact on debt financing costs, meaning superior ESG performance reduces a firm's debt financing expenses. Based on the regression results in column (3) incorporating all control variables, the coefficient for ESG's impact on COD is -0.000541, significant at the 1% level. This indicates that for each unit increase in a company's ESG score, its debt financing cost decreases by 0.000541 units. Thus, corporate ESG exerts a significant negative effect on COD, validating the study's hypothesis H1.

4.3. Robustness checks

For robustness checks, this study employs the following methods: robust standard error correction, exclusion of 2020 pandemic samples, reduction of the time period to use data from the past five years, and inclusion of industry

fixed effects. Considering the potential for heteroskedasticity in the large sample data, robust standard errors were applied for correction. Given the global impact of the 2020 COVID-19 pandemic, which caused widespread business suspensions in Chinese cities and disrupted corporate operations, the 2020 pandemic samples were excluded for robustness testing. To account for interference from long-term environmental changes, regression analysis was conducted using data from the five-year period 2020–2024 to perform further robustness testing. Finally, to address factors such as industry differences, industry fixed effects were incorporated to conduct robustness testing. The results are presented in **Table 3**.

Table 3. Robustness checks

VarName	(1) Robust standard error COD	(2) Exclude 2020 COD	(3) Using a sample from the past five years COD	(4) Add to industry fixed COD
ESG	-0.000541***	-0.000513***	-0.000209***	-0.000515***
	(-9.22)	(-8.23)	(-3.21)	(-8.80)
Size	0.0000613	0.0000365	-0.00216***	0.0000634
	(0.37)	(0.21)	(-4.63)	(0.38)
Lev	0.0189***	0.0188***	0.00787***	0.0190***
	(27.23)	(25.96)	(6.24)	(27.35)
INV	-0.0134***	-0.0134***	-0.0113***	-0.0127***
	(-11.83)	(-11.35)	(-4.33)	(-10.95)
ROA	-0.0201***	-0.0218***	-0.00883***	-0.0199***
	(-14.44)	(-14.60)	(-5.07)	(-14.36)
Cashflow	0.00896***	0.00951***	0.00485***	0.00859***
	(9.54)	(9.63)	(4.33)	(9.19)
Growth	-0.00167***	-0.00157***	-0.000778***	-0.00168***
	(-9.33)	(-8.37)	(-3.68)	(-9.41)
Top10	-0.00309***	-0.00295***	-0.000539	-0.00297***
	(-3.61)	(-3.33)	(-0.33)	(-3.47)
TobinQ	-0.000667***	-0.000682***	-0.000615***	-0.000626***
	(-9.01)	(-8.54)	(-6.87)	(-8.62)
ListAge	0.00496***	0.00481***	0.00813***	0.00511***
	(14.28)	(13.51)	(14.03)	(14.70)
_cons	0.00475	0.00564	0.0455***	0.00396
	(1.32)	(1.53)	(4.47)	(1.10)
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry				Yes
N	40462	37321	18644	40461
F	278***	258***	46***	274***
r2	0.641	0.640	0.820	0.645
r2_a	0.597	0.592	0.766	0.601

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Analysis of the regression results in **Table 3** reveals that, first, after applying cluster-robust standard errors at the firm level, the ESG variables' coefficients remain significantly negative at the 1% level, with t-values maintaining high significance. This indicates that the statistical significance of the main effects is highly robust. Moreover, whether excluding the 2020 sample severely impacted by the pandemic or restricting the sample to the past five years, the significant negative correlation between ESG and debt financing costs remains unchanged. This indicates that the relationship is not driven by short-term external shocks and remains stable under recent policy and market conditions. Finally, after controlling for industry fixed effects, the direction, magnitude, and significance level of the ESG coefficient remained highly consistent with the baseline model, confirming that the baseline findings are not attributable to unobservable heterogeneity across industries. The results of these four robustness tests collectively demonstrate the robustness of this study, preliminarily validating the reliability of the regression results.

4.4. Endogeneity treatment

For the endogeneity treatment, considering the potential reverse causality between corporate ESG performance and debt financing costs, where firms may proactively improve their ESG ratings to secure lower-cost financing, and the possibility of other omitted variables causing endogeneity issues, we employ two-stage least squares (2SLS) for endogeneity treatment. Following Gao *et al.* (2021), this study employs the average annual ESG composite score of listed companies within an industry as an instrumental variable [10]. This variable reflects the overall ESG practice trends and peer pressure within the industry, exhibiting strong correlation with individual firms' ESG levels and thus satisfying the instrument relevance requirement. Furthermore, the overall ESG level of an industry generally does not directly affect the debt financing conditions of individual firms, but primarily reflects common industry trends, satisfying the exclusion constraint and meeting the exogeneity requirement. Therefore, this instrumental variable effectively mitigates endogeneity bias, providing a reliable estimate for identifying the causal effect of ESG on debt financing.

The regression results in **Table 4** reveal that the first segment test indicates the coefficient of the instrumental variable IV on the explanatory variable ESG is 0.885, significant at the 1% level, suggesting a high correlation between the two. Simultaneously, the underidentification test statistic is 3225.324, significant at the 1% level, while the weak identification test statistic is 3123.404, exceeding the 10% critical value (10% maximal IV size) of 16.38. This indicates both tests are passed, confirming the validity of the instrumental variable. The second-stage results show that the coefficient for ESG's effect on COD is -0.00105, significant at the 1% level. This indicates that after addressing endogeneity issues using instrumental variables, ESG still exerts a significant negative impact on COD, further validating the accuracy of the regression results in this paper.

Table 4. Endogeneity treatment

VarName	(1) 2SLS Phase One ESG	(2) 2SLS Phase Two ESG
ESG		-0.00105***
		(-5.22)
IV	0.885***	
	(55.89)	
Size	0.342***	0.000246
	(29.22)	(1.64)
Lev	-0.902***	0.0184***
	(-19.19)	(32.63)

Table 4 (Continued)

VarName	(1) 2SLS Phase One ESG	(2) 2SLS Phase Two ESG
INV	0.161**	-0.0131***
	(2.21)	(-16.04)
ROA	0.534***	-0.0198***
	(5.43)	(-17.82)
Cashflow	-0.125*	0.00889***
	(-1.76)	(11.12)
Growth	-0.0685***	-0.00171***
	(-5.28)	(-11.67)
Top10	-0.0755	-0.00317***
	(-1.17)	(-4.39)
TobinQ	-0.0102*	-0.000674***
	(-1.84)	(-10.82)
ListAge	-0.243***	0.00487***
	(-8.57)	(15.21)
Firm	Yes	Yes
Year	Yes	Yes
N	40462	40462
F	479***	423***
r2	0.520	0.105
r2_a	0.461	-0.005

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.5. Moderation analysis

Moderation effects analysis was conducted based on the moderation effect model constructed in this paper, with results presented in **Table 5**.

Table 5. Moderation analysis

VarName	(1) COD
ESG	-0.00128***
	(-8.37)
PolicyESG	0.0211***
	(5.20)
Policy	-0.0856***
	(-3.94)
Size	0.0000543
	(0.41)
Lev	0.0189***
	(35.67)
INV	-0.0134***
	(-16.49)
ROA	-0.0200***
	(-18.12)

Table 5 (Continued)

VarName	(1) COD
Cashflow	0.00898***
	(11.25)
Growth	-0.00167***
	(-11.45)
Top10	-0.00313***
	(-4.34)
TobinQ	-0.000664***
	(-10.68)
ListAge	0.00498***
	(15.64)
_cons	0.00786***
	(2.67)
Firm	Yes
Year	Yes
N	40462
F	361***
r2	0.641
r2_a	0.597

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5 results show that the coefficient for ESG itself is -0.00128, indicating that improving ESG effectively reduces debt costs in the pre-policy period or control group. The coefficient for the interaction term between policy intensity and ESG is 0.0211, significant at the 1% level, suggesting that the marginal effect of ESG is substantially weakened after policy implementation. Calculations reveal that the net impact of ESG on debt costs may shift from negative to positive when policies are in place. Concurrently, the coefficient for policy intensity itself is -0.0856, significant at the 1% level, indicating that policies generally reduce financing costs for treated firms. However, this forms a "substitution" rather than a "complementary" relationship with the positive effects of ESG.

This dynamic can be explained through the lens of signaling theory and the transformation of credit allocation mechanisms. Prior to policy implementation, ESG performance served as a voluntary, differentiated non-financial signal. Banks could effectively identify "good firms" with lower environmental risks and superior governance, granting them preferential financing. After the policy's mandatory enforcement, enterprises in high-pollution industries universally undertook green transformations to meet compliance requirements, leading to overall convergence in ESG scores and diluting their signaling function [11]. Concurrently, banks' credit decision criteria shifted from comprehensive ESG scores to more specific green project reviews and rigid compliance requirements, diminishing the marginal informational value of ESG [12]. Furthermore, firms may incur additional compliance and transition costs to meet policy demands, potentially offsetting or even exceeding the financing benefits derived from ESG. This results in a decline in the net financing benefits of ESG under the policy context. This finding reveals how administrative environmental regulations may generate unintended "crowding-out effects" on market-driven green signaling mechanisms.

4.6. Difference-in-differences model analysis

Regression analysis based on the difference-in-differences model constructed in this paper is presented in **Table 6**.

Table 6. Difference-in-differences model analysis

VarName	(1) COD
ESG	-0.000553***
	(-9.64)
Post×Treat×ESG	0.000656*
	(1.94)
Post×Treat	0.00130
	(0.86)
Size	0.0000565
	(0.43)
Lev	0.0188***
	(35.59)
INV	-0.0132***
	(-16.26)
ROA	-0.0201***
	(-18.22)
Cashflow	0.00903***
	(11.32)
Growth	-0.00166***
	(-11.41)
Top10	-0.00317***
	(-4.40)
TobinQ	-0.000658***
	(-10.58)
ListAge	0.00492***
	(15.49)
_cons	0.00494*
	(1.74)
Firm	Yes
Year	Yes
N	40462
F	361***
r2	0.641
r2_a	0.597

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Based on the regression results in **Table 6**, the coefficient of the interaction term Post×Treat×ESG is 0.000656 and is positively significant at the 10% level. This indicates that after the implementation of the Green Credit

Guidelines, the role of ESG performance in reducing debt financing costs significantly weakened among enterprises subject to this policy. This supports the study's research hypothesis H2, namely that green credit policies exert a negative moderating effect on the debt financing impact of ESG. Economically, each unit improvement in ESG performance yields approximately 0.000656 fewer units of debt financing cost savings post-policy compared to pre-policy levels. This indicates the policy partially diminishes ESG's marginal contribution as a market signal in debt pricing. This outcome may stem from the tendency of high environmental risk firms to adopt compliance-oriented ESG behaviors after policy implementation, leading to homogenization of their signaling functions and consequently diminishing the differentiated value of ESG in credit decision-making.

4.7. Heterogeneity test

The heterogeneity analysis section first examines industry-level heterogeneity. Companies were categorized into state-owned enterprises (SOEs) and non-state-owned enterprises (NSOEs) based on ownership structure for heterogeneity analysis, with results presented in **Table 7**.

Table 7. Analysis of heterogeneity in property rights nature

VarName	(1) State-owned enterprise COD	(2) Non-state-owned enterprise COD
ESG	-0.000405***	-0.000587***
	(-4.48)	(-8.04)
Size	-0.000321	0.000464***
	(-1.48)	(2.63)
Lev	0.0184***	0.0188***
	(20.69)	(27.55)
INV	-0.0146***	-0.0119***
	(-11.17)	(-11.03)
ROA	-0.0196***	-0.0190***
	(-9.40)	(-14.48)
Cashflow	0.0115***	0.00720***
	(9.02)	(7.10)
Growth	-0.000932***	-0.00196***
	(-4.00)	(-10.65)
Top10	-0.00146	-0.00326***
	(-1.23)	(-3.43)
TobinQ	-0.000319***	-0.000767***
	(-2.74)	(-10.23)
ListAge	0.00248***	0.00548***
	(3.99)	(13.06)
_cons	0.0162***	-0.00349
	(3.33)	(-0.93)
Firm	Yes	Yes
Year	Yes	Yes
N	15259	25120
F	107***	262***
r2	0.658	0.653
r2_a	0.623	0.599

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in **Table 7**, the ESG coefficient for the state-owned enterprise group is -0.000405, significant at the 1% level. For the non-state-owned enterprise group, the ESG coefficient is -0.000587, also significant at the 1% level. Since both groups exhibit significant coefficients, a Fisher's exact test for group differences was further applied to compare the regression coefficients between the two groups. The results are presented in **Table 8**.

Table 8. Test for differences in intergroup coefficients of property rights nature

Variables	State-owned - Non-state-owned	Freq	*p*-value
ESG	0	93	0.070
Size	0.00100	1	0.010
Lev	0	64	0.360
INV	0.00300	10	0.100
ROA	0	49	0.490
Cashflow	-0.00400	98	0.020
Growth	-0.00100	100	0.000
Top10	-0.00300	92	0.080
TobinQ	0	98	0.020
ListAge	0.00300	0	0.000
cons	-0.0190	100	0.000

The results of the intergroup coefficient difference test in **Table 8** reveal that in 93 out of 100 sampling comparisons, the impact coefficient for non-state-owned enterprises was significantly higher than that for state-owned enterprises at the 10% significance level. This indicates that ESG performance exerts a more pronounced influence on corporate debt financing costs in non-state-owned enterprises. Heterogeneity analysis was conducted by regionally categorizing enterprises into eastern/central enterprises and western enterprises, with results presented in **Table 9**.

Table 9. Regional heterogeneity analysis

VarName	(1) East central COD	(2) Western COD
ESG	-0.000472***	-0.000850***
	(-7.81)	(-4.85)
Size	-0.0000460	0.0000970
	(-0.32)	(0.25)
Lev	0.0186***	0.0206***
	(32.43)	(13.51)
INV	-0.0127***	-0.0164***
	(-14.60)	(-6.62)
ROA	-0.0200***	-0.0190***
	(-16.98)	(-5.50)
Cashflow	0.00873***	0.0122***
	(10.30)	(4.77)

Table 9 (Continued)

VarName	(1) East central COD	(2) Western COD
Growth	-0.00170***	-0.00138***
	(-10.73)	(-3.43)
Top10	-0.00322***	-0.000849
	(-4.11)	(-0.42)
TobinQ	-0.000611***	-0.00100***
	(-9.12)	(-5.48)
ListAge	0.00500***	0.00470***
	(14.68)	(4.71)
_cons	0.00672**	0.00527
	(2.19)	(0.63)
Firm	Yes	Yes
Year	Yes	Yes
N	35309	4572
F	356***	58***
r2	0.641	0.626
r2_a	0.597	0.584

t statistics in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in **Table 9**, the ESG coefficient for the eastern and central enterprises group is -0.000472, significant at the 1% level. For the western enterprises group, the ESG coefficient is -0.000850, also significant at the 1% level. Since both groups' coefficients are significant, a Fisher's exact test was further applied to compare the regression coefficients between the two groups, with results presented in **Table 10**.

Table 10. Test for differences in intergroup coefficients among regions

Variables	Western-Central Eastern	Freq	*p*-value
ESG	0	5	0.0500
Size	0	58	0.420
Lev	-0.00200	67	0.330
INV	0.00400	29	0.290
ROA	-0.00100	65	0.350
Cashflow	-0.00400	82	0.180
Growth	0	59	0.410
Top10	-0.00300	83	0.170
TobinQ	0	8	0.0800
ListAge	0	57	0.430
cons	0	42	0.420

The results of the intergroup coefficient difference test in **Table 10** reveal that in 95 out of 100 sampling comparisons, the coefficient for western enterprises was significantly higher than that for eastern and central

enterprises at the 10% level. This indicates that ESG performance has a more pronounced impact on corporate debt financing costs in western enterprises.

5. Conclusion

5.1. Key findings

This study examines the impact of corporate ESG performance on debt financing costs using a sample of non-financial listed companies on China's A-share market from 2009 to 2024, with a particular focus on testing the moderating effect of the 2012 Green Credit Guidelines implementation. Key findings are as follows:

(1) ESG performance significantly reduces corporate debt financing costs. Both benchmark regression and a series of robustness tests confirm that strong ESG performance conveys positive sustainability signals to the market, alleviating information asymmetry and thereby substantially lowering debt financing costs;

(2) Green credit policies exert a negative moderating effect on the debt financing impact of ESG. Difference-in-differences analysis indicates that after policy implementation, the cost-reducing effect of ESG performance on debt financing costs is significantly weakened, suggesting that mandatory environmental regulations may generate a certain "crowding-out effect" on the market's spontaneous green signaling mechanism;

(3) The policy moderation effect exhibits pronounced heterogeneity. Panel regression results reveal that the weakening impact of green credit policies on ESG financing effects is more pronounced among non-state-owned enterprises and firms in western regions. This stems primarily from structural differences in financing constraints and regional institutional environments among these enterprises, rendering them more sensitive to external policy shocks.

5.2. Policy implications

Regulators should focus on improving ESG disclosure systems to promote standardized, transparent, and comparable ESG information. Our empirical results indicate that ESG performance can serve as an effective market signal to reduce corporate debt financing costs, highlighting the critical role of high-quality ESG information in mitigating information asymmetry and enhancing market pricing efficiency. Simultaneously, green credit policies have exerted a negative moderating effect on ESG financing outcomes for some enterprises, suggesting potential issues of "one-size-fits-all" approaches or signal homogenization during policy implementation. Therefore, while continuing to implement green credit policies, it is recommended to establish differentiated and targeted guidance mechanisms. These should incorporate enterprise ownership structures, industry attributes, and regional characteristics to design more flexible incentive-constraint tools. This approach would balance environmental objectives with market efficiency, enhancing the complementarity between policy and market signals.

In addition, financial institutions should systematically integrate ESG factors into credit rating and risk pricing models while accelerating innovation in green financial products. Research indicates that ESG performance lowers debt costs, underscoring ESG as a critical dimension for assessing long-term debt repayment capacity and operational stability. Banks and other lenders are advised to increase the weighting of ESG metrics in credit approval, interest rate pricing, and post-loan management. They should develop differentiated interest rate products tied to ESG performance, such as "ESG Performance Leader Preferential Loans" or "Green Transition Special

Financing," thereby directing more financial resources toward companies with outstanding ESG performance. This creates a virtuous cycle: improved ESG → reduced financing costs → increased green investment.

Finally, enterprises should deeply integrate ESG strategies with financial management systems, internalizing ESG development as a strategic initiative to enhance financing efficiency and long-term competitiveness. The heterogeneity analysis in this paper indicates that non-state-owned enterprises, non-manufacturing enterprises, and western enterprises exhibit greater sensitivity to ESG financing effects. This suggests these enterprises should proactively strengthen ESG governance, improve the quality and consistency of ESG disclosures, and actively build sustainable reputations. Enterprises may consider establishing dedicated ESG management departments, implementing performance evaluation mechanisms that link ESG outcomes to financial performance, and strengthening ESG communication with investors and creditors. This approach will more effectively translate ESG investments into financing advantages and market trust, ultimately achieving synergistic development of economic benefits alongside environmental and social benefits.

Disclosure statement

The author declares no conflict of interest.

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