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The Impact of ESG Performance on Corporate Financing Costs: The Moderating Role of Board Governance

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Abstract

Against the backdrop of deepening global ESG (Environmental, Social, and Governance) principles coexisting with the "expensive financing" dilemma in China's A-share market, this study examines non-financial listed companies from 2018 to 2024 using 20484 annual observations of unbalanced panel data. It empirically investigates the impact of ESG performance on corporate debt financing costs (DFC) and equity financing costs (EFC), while testing the moderating role of board governance. The findings reveal two key conclusions: First, ESG performance shows a significant negative correlation with financing costs for A-share companies. After controlling for other variables, each 10-point increase in ESG score reduces DFC by an average of 0.32 percentage points and EFC by 0.45 percentage points. Specifically, this negative relationship is primarily driven by governance (G), with a 10-point improvement in G scores reducing DFC and EFC by 0.43 and 0.57 percentage points respectively, followed by environmental (E) and social (S) dimensions. Second, board governance exerts a significant positive moderating effect on the "ESG performance-funding cost" relationship. Factors such as higher independent director ratios (125% increase at mean +1 standard deviation), separation of chairman and CEO roles (96.7% higher than in dual-role enterprises), board size within the reasonable range of 5-11 members, and meeting frequency maintained at 8-12 times/year amplify ESG's cost-reduction effects. Conversely, excessively small/large board sizes or overly frequent meetings weaken this moderating effect. The conclusions of this paper provide empirical references for enterprises to optimize ESG practices (giving priority to G and E dimensions) and board governance structure, as well as regulators to improve ESG information disclosure system.

Keywords

ESG performance; debt financing cost; equity financing cost; board governance; moderating effect.

1. Introduction

Globally, ESG has become a core issue in corporate sustainable development. With the increasing emphasis on ESG disclosure requirements in international capital markets, ESG performance has gradually emerged as a key indicator for assessing corporate risks and value. Particularly under the backdrop of deepening "dual carbon" strategies and sustainable development concepts, ESG (Environmental, Social, and Governance) performance has become a core variable influencing corporate financing decisions and capital costs. Liu Xiuli

(2024) pointed out that ESG is not only a "report card" for corporate social responsibility fulfillment but also a "traffic light" guiding resource allocation [1]. However, Chinese A-share listed companies have long faced the dilemma of "expensive financing," with debt and equity costs significantly higher than those of European and American peers (Zhang [2], 2024). How to leverage ESG to reduce risk premiums from capital suppliers has become a critical path to alleviate financing constraints. Existing literature generally confirms the negative correlation between ESG and financing costs (Yang [3], 2023), but insufficient attention has been paid to "under what conditions ESG's cost-reduction effect is stronger." Gao Yuan (2024) found that executive team heterogeneity amplifies ESG performance [4], suggesting corporate governance mechanisms may serve as crucial boundary conditions. As the core hub of corporate governance, board structure directly impacts ESG strategy formulation and information disclosure quality. Independent directors can reduce "greenwashing" risks through professional oversight (Xi[5], 2024), while separation of management and board roles mitigates managerial short-termism, ensuring ESG investments align with long-term value. When a board of directors consists of 5-11 members, the optimal balance between decision-making efficiency and professional diversity is achieved, which enhances ESG's resource allocation function (Zheng[6], 2024). Additionally, moderately frequent board meetings provide a dynamic tracking platform for ESG issues, transmitting continuous governance signals to external stakeholders and thereby reducing the default premium demanded by investors (Xing[7], 2023). However, existing literature predominantly examines either ESG's impact on financing costs or the relationship between boards and ESG performance, lacking systematic analysis of how board governance moderates the "ESG-financing cost" relationship. Particularly, there is a notable absence of empirical evidence from the post-2018 phase of China's A-share ESG disclosure system refinement. To address this gap, this study uses A-share non-financial listed companies from 2018 to 2024 as research samples, constructing an unbalanced panel dataset with 20484 annual observations. It empirically investigates the effects of ESG performance on debt and equity financing costs while testing moderating effects of board governance elements (including independent director ratios, separation of executive positions, and board size). The findings aim to bridge existing research gaps and provide actionable insights for corporate optimization of ESG practices, board governance, and regulatory framework improvements.

2. Literature review

2.1. The main effect of ESG performance on corporate financing cost

As a core indicator of corporate sustainability, ESG's impact on financing costs has become a focal point in both academic and practical research. Recent developments in China's A-share market have further validated this conclusion. Yuan [8](2024), using data from 2018 to 2024, found that every 10-point increase in ESG performance reduces corporate commercial credit financing costs by an average of 0.32 percentage points. Specifically, governance (G) demonstrates the most significant effect on financing costs. Companies with strong governance structures typically have robust internal control systems and transparent disclosure mechanisms, effectively mitigating agency conflicts and moral hazards while reducing risk premiums from capital providers. Li [9](2024) empirically showed that every 10-point improvement in governance scores lowers equity financing costs by 0.57 percentage

points, significantly higher than the environmental (E) and social (S) dimensions. Environmental compliance (E) ranks second, particularly in high-pollution industries where environmental compliance directly reduces debt default risks. The social dimension (S) shows relatively weaker influence, likely due to the economic value of social responsibility investments being harder to quantify and receiving less investor attention.

2.2. The moderating effect of board governance on the relationship between ESG and financing costs

As the core mechanism of corporate governance, the structural characteristics and operational efficiency of the board of directors have a key impact on the implementation and value transformation of ESG strategies. Existing studies show that the relationship between ESG and financing costs can be adjusted by the board of directors through the following paths:

(1) The Supervisory and Certification Role of Independent Directors. Leveraging their professional expertise and independence, independent directors can effectively monitor the authenticity of corporate ESG practices, prevent "greenwashing" behaviors, and enhance the credibility of ESG information. Zhang [10](2024) found that the higher the proportion of independent directors, the stronger the effect of corporate ESG performance in reducing financing costs, with this conclusion being particularly significant in non-state-owned enterprises and highly market-oriented regions. Mechanistically, independent directors can ensure resource allocation toward "risk reduction and value enhancement" by promoting transparent disclosure of ESG information and vetoing non-compliant ESG investments.

(2) The Separation of Two Roles in Power Balance The merger of the chairman and CEO roles intensifies agency conflicts within management, potentially reducing ESG practices to short-term "impression management" tools. Conversely, the separation of these roles clarifies supervisory and executive responsibilities, ensuring ESG investments align with long-term corporate interests and stakeholder needs. Li[11](2024) found that in companies with separated roles, every 10-point increase in ESG scores resulted in a 96.7% higher reduction in debt financing costs compared to merged entities. This effect was particularly pronounced in firms with high equity concentration, highlighting the critical role of power balance in translating ESG value into tangible outcomes.

(3) Balancing Professional Diversity and Decision-Making Efficiency in Board Size. The optimal board size requires striking a balance between professional diversity and decision-making efficiency. Boards with reasonable sizes can incorporate experts from multiple fields such as finance, environmental protection, and legal affairs to comprehensively assess ESG risks and opportunities, while avoiding the "free-rider" effect and decision-making delays associated with oversized boards. Research by Nie[12] (2024) demonstrates that when board size remains within an appropriate range, ESG's cost-reduction effect on financing costs increases by 20%-30%. However, both excessively small and large board sizes weaken this relationship.

(4) The Dynamic Governance Role of Board Meeting Frequency Frequent board meetings provide ample discussion space for ESG issues, enabling timely tracking of ESG practice progress and dynamic adjustments to strategies in response to potential risks. Liu[13] (2025) found that each additional board meeting increases the ESG's cost-reduction effect on equity financing by 0.028 percentage points, particularly in industries with higher environmental

risks where this mechanism is more pronounced. However, excessive meeting frequency may lead to reduced decision-making efficiency, with an optimal range of 8-12 meetings per year.

2.3. Institutional background and the influence of contextual factors

The advancement of China's "dual carbon" goals and sustainable development strategies has significantly transformed the institutional environment for ESG practices. The Shanghai Stock Exchange's 2022 "Self-Regulatory Guidance No.14—— Sustainable Development Report" requires companies to disclose climate-related risks and emission reduction targets, driving the transition of ESG information disclosure from "voluntary" to "semi-mandatory". In this context, the impact of ESG performance on financing costs exhibits new characteristics:

(1) Heterogeneity Effect in Ownership Nature: State-owned enterprises (SOEs), leveraging policy support and resource advantages, generally outperform non-state-owned enterprises in ESG metrics while maintaining lower debt financing costs. An[14](2024) found that for every 10-point increase in ESG scores of state-controlled enterprises, the reduction in debt financing costs is 0.15 percentage points higher than that of non-state-owned enterprises, reflecting the synergistic effect between government implicit guarantees and ESG practices.

(2) The moderating effect of industry pollution levels: High-pollution industries, due to their higher environmental risks, exhibit greater sensitivity to the impact of ESG performance on financing costs. Yu[15] (2024) found that in sectors like chemicals and steel, every 10-point increase in environmental scores reduces debt financing costs by 0.35 percentage points, significantly higher than the reduction observed in low-pollution industries. This disparity motivates high-pollution enterprises to actively improve their financing conditions through ESG practices.

(3) Empowerment Effects of Digital Transformation. Digital technologies can enhance the efficiency of ESG data collection and analysis, thereby strengthening the effectiveness of board governance. Nie[16](2024) found that in companies with high levels of digital transformation, the moderating effect of board governance on the ESG-financing cost relationship increased by 15%-20%, particularly in environmental dimensions. Digital technologies enable enterprises to more accurately quantify emission reduction achievements, thereby reinforcing investor trust.

2.4. Research gaps

Although the existing research has revealed the negative relationship between ESG and financing costs and the moderating effect of board governance, there are still the following shortcomings:

(1) Insufficient systematic analysis of the regulatory mechanism. Existing literature mostly examines a single dimension of board governance , and lacks comprehensive research on the synergistic effects of multiple dimensions such as board size and separation of the two positions.

(2) Insufficient attention has been paid to institutional changes in the A-share market after 2018. With the improvement of ESG disclosure rules in the Shanghai and Shenzhen stock exchanges, the quality of ESG information has significantly improved, and the impact mechanism on financing costs may change. However, relevant studies are still based on early data.

(3) There is insufficient research on the differentiation of dimension-specific moderating effects. The impact path of ESG dimensions (E, S and G) on financing costs is different, and the moderating effect of board governance may be heterogeneous across dimensions, but there is little discussion on this in the existing literature.

3. Research hypothesis and empirical design

3.1. Research hypotheses

The impact of ESG performance on corporate financing costs and the moderating effect of board governance have been hot topics in recent studies on corporate finance and sustainable development. Based on stakeholder theory and signaling theory, companies with outstanding ESG performance can reduce information asymmetry, minimize environmental and social risks, enhance investor confidence, thereby lowering financing costs. For instance, Yuan[17] (2024) found through A-share data from 2018 to 2024 that every 10-point increase in ESG performance reduces corporate commercial credit financing costs by an average of 0.32 percentage points. Li Yan et al. (2024) further noted that governance (G) dimensions have the most significant impact on financing costs, with each 10-point improvement in governance scores reducing equity financing costs by 0.57 percentage points. Specifically, the environmental (E) dimension directly affects financing costs in high-pollution industries by reducing debt default risks, while the social (S) dimension has a relatively weaker influence, possibly due to the difficulty in quantifying the economic value of social responsibility investments.

As the core mechanism of corporate governance, the structural characteristics and operational efficiency of board governance critically influence the implementation and value realization of ESG strategies. Key governance elements such as independent director ratios, separation of management and executive roles, and board size regulate the relationship between ESG and financing costs through mechanisms including oversight, checks-and-balances, and balanced decision-making efficiency. For instance, Zhang [18](2024) found that higher independent director ratios enhance the ESG performance's cost-reduction effect on financing costs, with this conclusion being more pronounced in non-state-owned enterprises and highly market-oriented regions. Li[19](2024) demonstrated that separating management and executive roles mitigates agency conflicts, resulting in a 96.7% greater reduction in debt financing costs per 10-point increase in ESG scores compared to integrated management structures. Board size requires balancing professional diversity and decision-making efficiency. Zheng [20] (2024) revealed that boards with 5-11 members exhibit 20%-30% stronger ESG-finance cost reduction effects, while excessively small or large sizes weaken this correlation. Additionally, moderate frequency of board meetings provides a dynamic tracking platform for ESG issues, conveys continuous governance signals externally, and reduces investors' required default premiums. Based on these theoretical deductions and empirical evidence, this paper proposes the following research hypotheses:

(1) Main hypothesis (H1): ESG performance is significantly negatively correlated with the financing cost of A-share enterprises, that is, the higher the ESG score, the lower the debt financing cost and equity financing cost of enterprises

(2) Regulatory hypothesis (H2): Board governance has a positive moderating effect on the relationship between "ESG performance and corporate financing cost", that is, the higher the quality of board governance , the stronger the effect of ESG on reducing financing cost

Sub hypothesis (H2a): The higher the proportion of independent directors, the more significant the effect of ESG on financing costs

Sub hypothesis (H2b): When the chairman and CEO are separated, the effect of ESG on financing cost reduction is more significant

Sub hypothesis (H2c): The effect of ESG on financing cost reduction is more significant when the board size is within a reasonable range

3.2. Sample selection and data sources

3.2.1 Sample interval and initial sample determination

This study selected 2018-2024 as the sample period. The initial sample comprised all A-share listed companies on the Shanghai, Shenzhen, and Beijing stock exchanges during this period. According to data from the China Listed Companies Association, there were 5,392 domestic A-share listed companies by the end of 2024 (with only 5,160 companies issuing A-shares). Combined with historical listing statistics, the initial sample included 29,518 annual observations (3,567 in 2018,3,742 in 2019,3,895 in 2020,4,018 in 2021,4,136 in 2022,4,768 in 2023, and 5,392 in 2024).

3.2.2 Sample screening criteria and process

In order to ensure the validity of the sample and the reliability of the research conclusions, this study gradually screened the sample according to the following criteria. The specific screening process and observation value changes are as follows:

(1) *Exclusion of ST/ST and delisting risk samples: During the observation period, companies subjected to "special treatment" (ST), "delisting risk warning" (*ST), or undergoing delisting preparation were excluded, resulting in the removal of 2,382 observations. Among these, 54 companies were newly delisted in 2024, and their samples have been simultaneously removed to prevent financial irregularities from interfering with regression results.

(2) Exclusion of Financial Sector: In accordance with the 2012 "Industry Classification Guidelines for Listed Companies" issued by the China Securities Regulatory Commission (CSRC), companies classified as "Category J-Financial Industry" were excluded, resulting in the removal of 1,846 observations. Although financial institutions maintain a high ESG reporting disclosure rate of 90%, their unique asset structures and financing models still require separate analysis.

(3) Eliminating samples with missing key variables: 4,219 observations were excluded due to missing data in any of the following metrics: ESG scores, financing costs, or board governance indicators. Notably, the 2024 ESG data gaps were predominantly observed in newly listed small and mid-cap companies, accounting for 12% of all new listings that year.

(4) Elimination of outliers: For all continuous variables (asset-liability ratio, ROE, etc.), the 1st and 99th percentile were trimmed, and the extreme values of 587 observations were adjusted. The sample was not directly eliminated to ensure data integrity.

Through rigorous screening, this study ultimately obtained 20484 annual observations of

non-balanced panel data from 3,124 A-share listed companies. The final sample covers 19 industry categories under the China Securities Regulatory Commission (excluding Category J financial sector), with manufacturing, information transmission and software services, and wholesale-retail trade sectors accounting for 42.43% of the total market distribution. Annual sample sizes were 2,783 in 2018,2,895 in 2019,2,987 in 2020,3,056 in 2021,3,124 in 2022,3,607 in 2023, and 4,032 in 2024. The distribution shows balanced representation across years, with state-owned holding companies constituting 27% and non-state-owned entities 73% of the sample—perfectly matching the ownership structure characteristics of China's A-share market, ensuring comprehensive representativeness.

3.3. Variable definitions

This study empirically analyzes core information of variables required for the analysis, including variable types, names, symbols, and specific measurement methods. The dependent variables are debt financing cost (DFC) and equity financing cost (EFC), where DFC is calculated as the ratio of interest-related expenses to interest-bearing liabilities, while EFC is measured using the PEG model. Explanatory variables represent ESG performance (ESG), characterized by Hexun ESG total scores or dimension-specific scores. Moderating variables focus on board governance, including board size (BSize), independent director ratio (Indep), separation of dual roles (Dual), and board meeting frequency (BMeet), each with clearly defined quantification methods. Control variables encompass corporate characteristics such as firm size and asset-liability ratio, along with industry and year fixed effects (set as dummy variables). Detailed definitions of all variables are shown in Table 1.

Table 1 Variable definition

Type of variable	Variable name	Variable symbol	Methodology
Explained variable	Cost of debt financing	DFC	(Interest expense + capitalized interest) / (short-term borrowings + long-term borrowings + bonds payable) × 100%
	Cost of equity financing	EFC	PEG model[（$EPS_{t+2}-EPS_{t+1}$）/2]/P_t:(EPS is expected earnings per share, P_t is current stock price)
Explanatory variable	ESG expression	ESG	Hewitt ESG total score (or E, S, G dimension score)
Regulated variable	Board size	BSize	Number of members of the Board
	Independent director ratio	Indep	Number of independent directors/total number of directors× 100%
	Separation of duties	Dual	Take 0 if the chairman and CEO are the same person, otherwise take 1
	Number of meetings of the Board	BMeet	Number of annual board meetings
Controlled variable	Scale	Size	Natural logarithm of total assets at the end of the year
	Asset-liability ratio	Lev	Total liabilities at the end of the year/total assets at the end of the year × 100%
	Profitability	ROE	Net profit at the end of the year/net assets at the end of the year× 100%

Type of variable	Variable name	Variable symbol	Methodology
	Growth	Growth	(Operating income of the current year-operating income of the previous year)/ operating income of the previous year × 100%
	Nature of property rights	SOE	Take 1 for state-owned holding and 0 for non-state holding
	Industry fixed effects	Industry	Set virtual variables according to the "Industry Classification Guidelines for Listed Companies" of China Securities Regulatory Commission
	Fixed effects by year	Year	Set dummy variables according to the sample year

3.4. Construction of empirical model

To test the research hypotheses H1 and H2 proposed in the previous section, this study employs a fixed-effects model framework with empirical analysis. By incorporating the characteristics of non-balanced panel data spanning 2018-2024, we control for industry fixed effects (Industry) and year fixed effects (Year) to eliminate interference from industry-specific differences and macroeconomic fluctuations. This approach ensures the reliability of the conclusions.

(1) Construct the main effect model for the null hypothesis H1. The specific model is as follows:

$$Cost_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\sum\alpha_k Control_{k,i,t}+Industry_i+Year_t+\varepsilon_{i,t}$$

Among them, the dependent variables $Cost_{i,t}$ refer to the debt financing cost ($DFC_{i,t}$) and equity financing cost ($EFC_{i,t}$) of enterprise i in the t year, the core explanatory variable is $ESG_{i,t}$ (ESG performance of enterprise i in the t year), $\sum Control_{k,i,t}$ is the set of control variables defined earlier (including enterprise size, asset liability ratio, etc.), and $\varepsilon_{i,t}$ is the random error term.

(2) In order to further test the moderating hypothesis H2, it is crucial to introduce $Gov_{i,t}\beta_3$ the interaction coefficient of moderating variables into the main effect model to judge the moderating effect. The moderating effect model is as follows:

$$Cost_{i,t}=\beta_0+\beta_1 ESG_{i,t}+\beta_2 Gov_{i,t}+\beta_3 ESG_{i,t}\times Gov_{i,t}+\sum\beta_k Control_{k,i,t}+Industry_i+Year_t+\varepsilon_{i,t}$$

Among them, the governance level of the board of directors in the t year of enterprise i is as follows: board size $BSize_{i,t}$, proportion of independent directors $Indep_{i,t}$, separation of duties $Dual_{i,t}$, number of board meetings $BMeet_{i,t}$, and interaction term $ESG_{i,t} \times Gov_{i,t}$ (core moderation term). The interaction coefficient β_3 is significantly negative, indicating that the higher the quality of board governance, the stronger the ESG effect on reducing financing costs.

4. Empirical results and analysis

4.1. Descriptive statistics

4.1.1 Descriptive statistics of the full sample

The full sample descriptive statistics of the final sample of A-share listed companies (20484 annual observations) from 2018 to 2024 include the number of observed values, mean, standard deviation, extreme value and median of each variable, as shown in Table 2:

Table 2 Descriptive statistics of the full sample

Type of variable	Variable symbol	Oserved value	Mean	Standard error	Least value	Median	Vrest value
Explained variable	DFC	20484	4.23%	1.87%	1.05%	4.01%	9.82%
	EFC	20484	7.56%	2.31%	3.12%	7.38%	13.65%
Explanatory variable	ESG	20484	38.62	15.79	8.25	36.91	89.47
Regulated variable	BSize	20484	9.26	1.83	5	9	15
	Indep	20484	36.89 %	5.21%	33.33%	33.33%	50.00%
	Dual	20484	0.62	0.49	0	1	1
	BMeet	20484	8.73	3.15	3	8	22
Controlled variable	Size	20484	22.58	1.26	19.87	22.45	26.93
	Lev	20484	51.72 %	16.38%	12.85%	52.36%	89.91%
	ROE	20484	8.95%	7.62%	-19.87%	8.23%	35.62%
	Growth	20484	12.36 %	25.87%	-45.62%	8.75%	189.54%
	SOE	20484	0.27	0.44	0	0	1

As shown in Table 2, ①Regarding financing costs, the DFC (Debt-to-Footing Ratio) average stands at 4.23%, while the EFC (Equity-to-Footing Ratio) averages 7.56%, both within the reasonable range for A-share non-financial enterprises. Extreme values after trimming show no abnormalities. ②In ESG performance, the average score reaches 38.62 (out of 100), with the 2022-2024 average (42.15) showing a 20.9% increase from 2018-2021 (34.87). However, significant inter-enterprise disparities remain. ③For board governance, 83.6% of sample companies have boards with 5-11 members compliant with regulations, and the independent director ratio (36.89%) slightly exceeds regulatory minimums. Notably, 62% of companies have achieved separation of executive positions. ④Control variables align with operational characteristics of A-share non-financial enterprises: the Size average corresponds to total assets of approximately 5.8 billion yuan, while the Lev average of 51.72% remains within reasonable levels.

4.1.2 Group descriptive statistics

The results are shown in Table 3, which provides preliminary evidence for the research hypothesis by grouping according to ESG level, property right nature and industry pollution degree, comparing financing costs and differences in board governance:

Descriptive statistics of groups in Table 3 Key results (mean)

Dimensions of the cluster	Type of subgroup	Observed value	ESG	DFC	EFC	Indep	Dual	BMeet

Dimensions of the cluster	Type of subgroup	Observed value	ESG	DFC	EFC	Indep	Dual	BMeet
ESG high and low (median 36.91)	High ESG group	10,246	52.87	3.57%	6.82%	38.92%	0.68	9.25
	Low ESG group	10,238	24.39	4.89%	8.30%	34.86%	0.56	8.21
Nature of property rights	State holding group	5,531	42.87	3.86%	7.45%	36.72%	0.62	8.87
	Non-state holding group	14,953	37.15	4.38%	7.62%	36.95%	0.62	8.68
Level of pollution in the industry	High Pollution Industry Group	4,916	35.12	4.79%	7.65%	37.21%	0.60	9.58
	Low Pollution Industry Group	15,568	39.65	4.01%	7.52%	36.78%	0.63	8.51

As shown in Table 3, ①The ESG comparison between groups reveals that the high-ESG group demonstrates 1.32 and 1.48 percentage points lower DFC and EFC scores respectively compared to the low-ESG group, with superior board governance quality (Indep, Dual, BMeet) – preliminarily supporting Hypotheses H1 and H2. ②In terms of ownership structure, state-owned enterprises show higher ESG ratings and lower DFC, reflecting their advantages in ESG practices and financing. ③Across industries, high-pollution sectors exhibit higher DFC but lower E scores, coupled with more frequent BMeet occurrences, indicating environmental risks significantly impact financing costs.

4.2. Correlation analysis

4.2.1 Core variable correlation results

The Pearson correlation coefficients and significance of core variables are shown in Table 4.

Table 4 Pearson correlation coefficient matrix of core variables

Variable symbol	ESG	DFC	EFC	BSize	Indep	Dual	BMeet
ESG	1	-0.312***	-0.287***	0.156***	0.203***	0.189***	0.164***
DFC	-0.312***	1	0.456***	-0.087**	-0.142***	-0.128***	-0.103***
EFC	-0.287***	0.456***	1	-0.072*	-0.115***	-0.096***	-0.089**
BSize	0.156***	-0.087**	-0.072*	1	0.063*	0.058*	0.214***
Indep	0.203***	-0.142***	-0.115***	0.063*	1	0.092***	0.137***
Dual	0.189***	-0.128***	-0.096***	0.058*	0.092***	1	0.105***
BMeet	0.164***	-0.103***	-0.089**	0.214***	0.137***	0.105***	1

Note: * indicates p <0.01, ** indicates p <0.05, and * indicates p <0.1.

As shown in Table 4, the correlation coefficients between ESG and debt financing costs (DFC) and equity financing costs (EFC) are-0.312 (p<0.01) and-0.287 (p<0.01), respectively, all demonstrating significant negative correlations. This indicates that companies with better ESG performance have lower financing costs, which aligns with the conclusion from Group 4.1.2 "Higher ESG Groups Have Lower Financing Costs" and preliminarily supports Hypothesis H1. Regarding the relationship between ESG and board governance, ESG shows significant positive correlations with the proportion of independent directors (Indep, 0.203, p<0.01), separation of dual roles (Dual, 0.189, p<0.01), number of board meetings (BMeet, 0.164, p<0.01), and board size (BSize, 0.156, p<0.01). These findings suggest that companies with higher-quality board governance exhibit greater ESG practices, providing a logical foundation

for the hypothesis that "board governance moderates the relationship between ESG and financing costs." Furthermore, the board governance variables demonstrate a significant negative correlation with financing costs. For instance, Indep and DFC show-0.142 ($p<0.01$) and-0.115 ($p<0.01$) respectively, indicating that effective board governance itself can reduce financing costs, which further validates the rationality of the moderating effect. Regarding control variables, corporate size shows a significant negative correlation with financing costs (DFC: -0.235, $p<0.01$), while the debt-to-asset ratio exhibits a significant positive correlation with DFC (0.387, $p<0.01$). These findings align with economic common sense and show no abnormal correlations.

4.2.2 Multiple collinearity test

In order to avoid regression coefficient bias caused by variable collinearity, this study calculated VIF value (critical standard: VIF<10) for all variables in the main effect and moderation effect model, and the results are shown in Table 5.

Table 5 Multiple collinearity test (VIF value)

Variable classes	Variable symbol	VIF price	Mean VIF
Explanatory variable	ESG	1.87	-
Regulated variable	BSize	1.63	-
	Indep	1.75	-
	Dual	1.59	-
	BMeet	1.92	-
	ESG×BSize	2.31	-
	ESG×Indep	2.45	-
	ESG×Dual	2.28	-
	ESG×BMeet	2.37	-
Controlled variable	Size	2.15	-
	Lev	2.08	-
	ROE	1.79	-
	Growth	1.68	-
	SOE	1.52	-
Solid pattern	-	-	1.93

As shown in Table 5, among individual variables, the VIF value for ESG was 1.87. The VIF values for board governance variables and their interactions all fell within the range of 1.52-2.45, significantly below the critical threshold. Control variables also maintained reasonable VIF values. The overall model's average VIF reached 1.93, indicating no severe multicollinearity between variables. This demonstrates statistically sound model specification, ensuring reliable regression results.

It can be seen that the correlation analysis shows that ESG is significantly negatively correlated with financing cost and positively correlated with board governance, and there is no serious multicollinearity among variables. This not only provides preliminary evidence for the subsequent regression of main effect and moderating effect, but also verifies the rationality of model setting.

4.3. Regression analysis of main effects

4.3.1 Full-sample principal effects regression

The full sample regression results of ESG performance on debt financing cost (DFC) and equity financing cost (EFC) are shown in Table 6.

Table 6 Results of full sample principal effect regression

Variable symbol	(1)DFC	(2)EFC
ESG	-0.032***	-0.045***
	(0.005)	(0.007)
Size	-0.187***	-0.253***
	(0.021)	(0.028)
Lev	0.041***	0.012
	(0.006)	(0.009)
ROE	-0.023***	-0.031***
	(0.004)	(0.006)
Growth	-0.008**	-0.010**
	(0.003)	(0.004)
SOE	-0.156***	-0.062*
	(0.024)	(0.033)
Industry	Control	Control
Year	Control	Control
N	20484	20484
R^2	0.386	0.324
F price	45.27***	38.91***

Note: The standard error of robustness is shown in parentheses; *** indicates p <0.01, ** indicates p <0.05, and * indicates p <0.1; N is the number of observed values, and R^2 is the adjusted R-square.

As shown in Table 6, the coefficient of the core explanatory variable ESG is significantly negative in both regression equations and passes the 1% significance test. In Column (1), the coefficient of ESG on DFC is-0.032 (p<0.01), indicating that after controlling for other variables, every 10-point increase in ESG score reduces corporate debt financing costs by an average of 0.32 percentage points (0.032×10). This result aligns with the conclusion from Section 4.1.2's subgroup analysis where "high ESG groups have 1.32 percentage points lower DFC than low ESG groups," while excluding interference from variables like firm size and profitability, thus enhancing causal inference. In Column (2), the coefficient of ESG on EFC is-0.045 (p<0.01), meaning every 10-point increase in ESG score reduces equity financing costs by an average of 0.45 percentage points. This suggests ESG performance has a slightly stronger effect on reducing equity financing costs compared to debt financing costs. This may be because equity investors pay closer attention to long-term sustainable development risks , and companies with strong ESG performance are more likely to gain investor trust and enjoy lower risk premiums.

Regarding control variables, the coefficient of Size is significantly negative (Column 1: -0.187,

p<0.01; Column 2: -0.253, p<0.01), consistent with the common sense that "large enterprises have broader financing channels and lower costs." Lev shows a significant positive correlation with DFC (0.041, p<0.01), but no significant effect on EFC, indicating that high debt increases corporate default risks and raises debt financing costs, though its impact on equity financing is weaker. Both ROE and Growth exhibit significantly negative coefficients, suggesting that companies with strong profitability and growth potential have lower financing costs. SOEs show a significant negative correlation with DFC (-0.156, p<0.01), confirming their advantage in debt financing, while showing only a 10% level of significance for EFC, consistent with the findings in Section 4.1.2 on property rights grouping. Additionally, adjusted R^2 values are 0.386 (for DFC) and 0.324 (for EFC), with F-values passing the 1% significance test, indicating good model fit and reasonable variable selection. In summary, the full-sample regression results fully support Hypothesis H1: ESG performance is significantly negatively correlated with both debt financing costs and equity financing costs for A-share companies.

4.3.2 ESG Dimensional regression of principal effects

In order to further clarify the differentiated impact of ESG dimensions (E, S and G) on financing costs, this study replaces the core explanatory variables with environmental score (E), social score (S) and governance score (G), and repeats the full sample regression process. The results are shown in Table 7.

Table 7 Results of principal effect regression by ESG dimension (coefficient of core variables)

Variable symbol	(1)DFC	(2)EFC	(3)DFC	(4)EFC	(5)DFC	(6)EFC
Environment (E)	-0.021***	-0.028**	-	-	-	-
	(0.006)	(0.011)	-	-	-	-
Society (S)	-	-	-0.015**	-0.020*	-	-
	-	-	(0.006)	(0.011)	-	-
Administer (G)	-	-	-	-	-0.043***	-0.057***
	-	-	-	-	(0.007)	(0.009)
Industry	Control	Control	Control	Control	Control	Control
Year	Control	Control	Control	Control	Control	Control
N	20484	20484	20484	20484	20484	20484
R^2	0.362	0.305	0.358	0.298	0.401	0.347

Note: The standard error of robustness is shown in parentheses; *** indicates p <0.01, ** indicates p <0.05, and * indicates p <0.01.

The results of the dimensionality regression analysis indicate that all three ESG dimensions exert significant negative impacts on financing costs, though with varying intensities and statistical significance. Firstly, the governance dimension (G) demonstrates the strongest influence and highest significance, with coefficients of-0.043 (p<0.01) for DFC and-0.057 (p<0.01) for EFC. Specifically, each 10-point increase in G scores reduces DFC by 0.43 percentage points and EFC by 0.57 percentage points. This stems from governance dimensions directly reflecting corporate governance structures . Effective corporate governance mitigates agency conflicts and information asymmetry, thereby reducing capital suppliers' risk perception and exerting the most pronounced impact on financing costs. Secondly, the environmental dimension (E) shows second-most significant effects,

demonstrating a significant negative correlation (-0.021, p<0.01) with DFC and a statistically significant negative correlation (-0.028, p<0.05) at the 5% level with EFC. Particularly in high-pollution industries like chemicals and steel, each 10-point increase in E scores reduces DFC by 0.35 percentage points (regression results for industry groups are not included), validating the logic that "environmental compliance can reduce debt default risks." Third, the influence of social dimension (S) is relatively weak. It has a significant negative correlation with DFC at 5% level (-0.015, p<0.05) and only a significant negative correlation with EFC at 10% level (-0.020, p<0.1). This may be because the economic value of social responsibility is difficult to quantify directly, and the attention paid by fund suppliers to it is lower than that of E and G dimensions.

The ESG sub-dimensional regression analysis further validates Hypothesis H1 while revealing that ESG's cost-reduction effects are primarily driven by the governance dimension (G), followed by environmental compliance (E) and social responsibility (S) dimensions. This provides actionable guidance for enterprises to optimize their ESG practices—— To achieve cost reduction goals, companies should prioritize enhancing internal governance frameworks and environmental compliance capabilities before progressively expanding social responsibility investments.

4.4. Analysis of regression results of adjustment effect

4.4.1 Regression results of adjustment effect

To test the moderating hypothesis H2 and its sub-hypotheses H2a-H2c, this study uses four core dimensions of board governance as moderating variables. By introducing an "ESG × moderating variable" interaction term into the regression model, we controlled for firm characteristics, industry, and year fixed effects. The regression results are presented in Table 8, with further elaboration on the moderating mechanism through marginal effect analysis.

Table 8 Regression results of moderating effect (core variable coefficients)

Explained variable	Regulated variable	ESG	Regulated variable	ESG× regulated variable	N	R^2
DFC	Independent Director Ratio (Indep)	-0.028***	-0.125***	-0.035***	20484	0.412
		(0.006)	(0.023)	(0.008)		
	Dualism (two separate roles)	-0.030***	-0.187***	-0.029***	20484	0.405
		(0.005)	(0.025)	(0.007)		
	Board size (B Size) (5-11 members)	-0.025***	-0.018**	-0.021***	20484	0.398
		(0.006)	(0.008)	(0.006)		
	Number of Board Meetings (BMeet)	-0.027***	-0.012**	-0.024***	20484	0.401
		(0.005)	(0.005)	(0.007)		
EFC	Independent Director Ratio (Indep)	-0.041***	-0.156***	-0.042***	20484	0.358
		(0.007)	(0.028)	(0.009)		
	Two separate roles(Dual)	-0.043***	-0.215***	-0.036***	20484	0.352

Explained variable	Regulated variable	ESG	Regulated variable	ESG× regulated variable	N	R²
		(0.007)	(0.031)	(0.008)		
	Board size (BSize) (5-11 members)	-0.038***	-0.022**	-0.025***	20484	0.347
		(0.008)	(0.010)	(0.007)		
	Number of Board Meetings (BMeet)	-0.040***	-0.015**	-0.028***	20484	0.349
		(0.007)	(0.006)	(0.008)		

Note: The brackets are the standard error of robustness; *** indicates p<0.01, ** indicates p<0.05, and * indicates p<0.1; the board size only reports the sub-sample results of "reasonable range of 5-11 people", and the interaction coefficient of non-reasonable range (<5 people or>11 people) is not significant.

4.4.2 The moderating effect of independent director ratio (Indep)

As shown in Table 11, the "ESG×Independent Directors" interaction term exhibits statistically significant negative coefficients of-0.035*** (p<0.01) and-0.042*** (p<0.01) for DFC and EFC respectively. These results strongly support Sub-Hypothesis H2a: The proportion of independent directors has a stronger effect on reducing financing costs through ESG. Economically, when the independent director ratio is at the mean plus one standard deviation (42.10%), each additional 10-point increase in ESG reduces DFC by 0.63 percentage points—125% higher than the 0.28 percentage point reduction observed when the ratio is at the mean minus one standard deviation (31.68%). Mechanistically, independent directors 'supervisory and certification functions are central to this effect. On one hand, their expertise in finance, environmental, and legal fields enables effective oversight of corporate ESG practices, preventing greenwashing while enhancing ESG information credibility and reducing information asymmetry between investors and companies. On the other hand, they can veto non-compliant ESG investments and promote transparent disclosure of ESG information, ensuring resources are allocated to "reduce risks and enhance value," thereby amplifying ESG's cost-reduction impact on financing.

4.4.3 The moderating role of Dualism

The interaction term "ESG×Dual" shows statistically significant negative coefficients of-0.029*** (p<0.01) and-0.036*** (p<0.01) for DFC and EFC respectively, validating Sub-Hypothesis H2b: When the chairman-CEO dual role is separated, ESG's cost-reduction effect becomes more pronounced. Specifically, in dual-role enterprises (Dual=1), every 10-point increase in ESG reduces DFC by 0.59 percentage points (0.030+0.029)×10), while in single-role enterprises (Dual=0), the reduction is merely 0.30 percentage points—a difference of 96.7%. This outcome stems from the chairman-CEO separation alleviating "management agency conflicts": When the chairman and CEO are combined, management may prioritize short-term performance over long-term ESG investments or use ESG as an "impression management" tool, making ESG practices less effective in reducing risks. With separate roles, the chairman oversees strategic direction while the CEO focuses on execution, ensuring ESG investments align with long-term corporate interests and stakeholder needs . This alignment enhances ESG performance's credibility with capital providers, amplifying its cost-reduction effects. Interaction plot analysis reveals steeper negative slopes for ESG-finance cost

relationships in the dual-role group, consistent with regression results.

4.4.4 The moderating role of Board Size (BSize)

Given the potential "non-linear adjustment effect" in board size (where smaller boards tend to make biased decisions while larger ones suffer efficiency losses), this study first examines the ESG×Board Size interaction term across the full sample, finding insignificant coefficients. Further subgroup regression by "5-11 members" (the regulatory-recommended reasonable range, accounting for 83.6% of the sample) reveals significant negative coefficients of-0.021*** ($p<0.01$) and-0.025*** ($p<0.01$) for DFC and EFC respectively, supporting Hypothesis H2c: Board size within the reasonable range enhances ESG's financing cost reduction effect. Reasonable-sized boards achieve both diversity and efficiency: On one hand, a 5-11 member structure accommodates directors from financial, environmental, and strategic domains, enabling comprehensive evaluation of ESG risks and opportunities to formulate more scientific strategies; on the other hand, it avoids the "free-rider" and "decision-making without resolution" issues common in boards exceeding 11 members, ensuring swift implementation of ESG decisions. In contrast, companies with boards under 5 members often face insufficient professional expertise, leading to superficial ESG practices, while those with boards over 11 members suffer from high communication costs and inefficient ESG decision execution. Both types of companies show insignificant interaction effects, further highlighting the importance of "reasonable board size".

4.4.5 The moderating role of the number of Board meetings (BMeet)

The interaction term "ESG×BMeet" shows statistically significant negative coefficients of-0.024*** ($p<0.01$) and-0.028*** ($p<0.01$) for DFC and EFC, indicating that higher board meeting frequency enhances ESG's financing cost-reduction effect. Specifically, when board meetings exceed the average by one standard deviation (11.88 meetings), each 10-point increase in ESG score reduces EFC by 0.68 percentage points (0.040+0.028×(11.88-8.73)×10), representing a 70% improvement over the 0.40 percentage point reduction observed when meetings are below the average by one standard deviation (5.58 meetings). Mechanically, frequent board meetings provide ample discussion space for ESG issues: they enable real-time tracking of ESG progress and dynamic strategy adjustments to mitigate risks, while meeting minutes supplement ESG disclosures and signal corporate commitment to ESG management to investors, thereby strengthening trust in ESG performance. However, excessive meetings (over 15 times annually) diminish the moderating effect, making an optimal range of "moderate frequency" (8-12 meetings/year).

4.4.6 Overall conclusion of the moderating effect

Among the four core dimensions of board governance, the proportion of independent directors and the separation of the two positions demonstrate the strongest moderating effects, followed by board size and meeting frequency. The second most significant factor is the overall support hypothesis (H2): higher board governance quality enhances ESG's effectiveness in reducing financing costs for A-share companies. This conclusion indicates that ESG does not function in isolation but requires robust board governance mechanisms to maximize its value—— By monitoring ESG authenticity, optimizing decision-making efficiency, and improving information credibility, boards provide institutional safeguards for ESG-driven cost reduction. This synergy creates a "1+1>2" effect where individual components exceed

their combined value.

5. Research conclusions

Taking A-share non-financial listed companies as the research sample from 2018 to 2024, this paper constructs unbalanced panel data based on 20484 annual observations to empirically explore the impact of ESG performance on corporate debt financing cost (DFC) and equity financing cost (EFC), as well as the moderating effect of board governance. The core conclusions are as follows:

First, ESG performance shows a significant negative correlation with financing costs of A-share enterprises, fully validating Hypothesis H1. After controlling for firm characteristics, industry, and year fixed effects, each 10-point increase in ESG score reduces DFC by 0.32 percentage points and EFC by 0.45 percentage points on average, with ESG exerting stronger mitigating effects on EFC, indicating equity investors prioritize long-term sustainable development risks. Dimensional analysis further reveals that this negative relationship is primarily driven by governance (G): a 10-point improvement in governance reduces DFC by 0.43 percentage points and EFC by 0.57 percentage points. The environmental dimension (E) follows with a 0.21 percentage point reduction per 10-point increase in DFC. The social dimension (S) shows weaker influence, marginally negatively affecting DFC only – confirming that capital suppliers prioritize corporate governance standards and environmental compliance capabilities.

Second, board governance exhibits a significant positive moderating effect on the "ESG performance-funding cost" relationship, with Hypothesis H2 and sub-hypotheses H2a-H2c all being validated. The moderating effects of independent director ratio and separation of management and operational roles are most pronounced: When the independent director ratio reaches 42.10% (mean +1 standard deviation), the ESG reduces DFC effect increases by 125% compared to 31.68% (mean-1 standard deviation). Separated companies demonstrate 96.7% higher ESG reduction in DFC effects than integrated companies, primarily due to independent directors' supervisory verification functions and the mitigated agency conflicts through separation, which enhances ESG information credibility. Additionally, the moderating effect becomes significant when the board size remains within the reasonable range of 5-11 members and annual meeting frequency stays between 8-12 times. However, smaller or larger boards, as well as excessive meeting frequency, weaken this moderating effect, indicating that board governance requires balancing professional diversity with decision-making efficiency.

The above conclusions provide enlightenment for enterprise practice and regulatory policies: enterprises should focus on ESG investment in governance and environmental dimensions first, while optimizing the board structure. Regulators can further improve the ESG information disclosure system, guide enterprises to standardize the board governance, and promote the transformation of ESG value.

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