

Research on the Impact of ESG Performance on Cost of Corporate Debt Financing

Entian Li ^{1, *}, Jiabeizi Yu ²

¹ School of Economics, Guangdong Ocean University, Zhanjiang, China, 524088

² Faculty of Business Administration, University of Macau, Macau, China, 999078

* Corresponding author: 13711115aa@stu.gdou.edu.cn

Abstract. Over the past few years, green finance has emerged as a pivotal catalyst for the robust economic growth in China, achieving a level of standardization in its development. Concurrently, the ethos of responsible investment, anchored in Environmental, Social, and Governance (ESG) criteria, has increasingly captured the spotlight. This research leverages the CSMAR database to examine the A-share listed companies in China spanning 2009 to 2023, employing STATA16.0 for data analysis. The study's sample curation excludes ST/*ST firms, financial industry entities, and those with incomplete financial records. Additionally, the primary continuous variables were capped at the 1% and 99% quantiles to mitigate the impact of outliers, followed by descriptive statistics and correlation analysis, culminating in panel data regression model. The investigation zeroes in on the correlation between a company's ESG performance and the robustness of its corporate debt financing costs, with robustness tests adjusted for temporal considerations and alternative explanatory variables. The findings reveal a substantial negative correlation, suggesting that companies with superior ESG performance incur lower debt financing costs. This correlation is particularly pronounced among non-state-owned enterprises (non-SOEs). This underscores that in a fiercely competitive credit market, non-SOEs prioritize enhancing their brand value and market standing through ESG performance as a strategic move to bolster their intangible assets, thereby securing more favorable financing terms. Consequently, creditors should recognize the significance of a company's ESG performance, which is crucial for mitigating potential risks and ensuring the sustained and stable growth of businesses.

Keywords: ESG Performance; Cost of Corporate Debt Financing; Green Finance; Non-State-Owned Enterprises; Sustainable Development.

1. Introduction

Green development has become a highlight of contemporary society, representing the transformation of the economy to higher-quality growth. The 20th National Congress of the CPC highlighted “advancing green growth and fostering a harmonious relationship between humanity and nature” as a strategic policy, underscoring its significance. The report emphasized that “achieving high-quality development is the main objective in fully constructing a modern socialist nation”, and noted that “shifting economic and social development towards a green and low-carbon trajectory is essential for attaining high-quality development.” ESG, as an investment philosophy and corporate assessment framework, transcends the conventional financial metrics, placing greater emphasis on a company's environmental stewardship, social accountability, and governance mechanisms. This approach aligns with the extensive societal demands and is a natural outcome of the global sustainable development movement. It represents a crucial strategic decision for China in its pursuit of high-quality economic growth and the facilitation of economic structural transformation.

ESG performance is playing an increasingly prominent role in enterprise evaluation systems, and it has become a consensus in the industry to take it as a key factor to measure the comprehensive performance of enterprises. The Cost of debt financing not only reflects the financial health of enterprises but also is an important indicator to evaluate their sustainable development ability, which has attracted more and more attention from banks, bond markets, and other capital providers. During

the loan decision-making process, which encompasses crucial elements like loan size, interest rates, and repayment schedules, a company's ESG performance has emerged as a significant factor. The question of how to leverage enhanced ESG performance to lower the expenses associated with debt financing, thereby fostering high-quality development, has drawn the collective interest of government bodies, businesses, and scholarly research communities.

Within the realm of green finance, this empirical study delves into the correlation between a company's ESG performance and its debt financing costs while also examining the influence of corporate ownership structure on this relationship, using China's A-share listed companies from 2009 to 2023 as the sample. The findings are intended to offer empirical evidence to assist listed companies in refining their ESG management practices, holding significant value for both academic and practical applications. In the practical sphere, aligning with China's green policies, the paper encourages leading enterprises to prioritize ESG performance within their strategic planning and operational activities. This emphasis is pivotal for fostering a collaborative effort among corporate creditors, investors, and regulators to establish a responsible investment framework and a green financial system.

2. Literature review

2.1. Economic consequences of ESG performance

According to existing research, the economic consequences of ESG performance are mainly carried out from two aspects: stock market and enterprise operation.

From the perspective of the stock market, most researchers generally believe that the excellent ESG performance of enterprises can have a positive impact on the stock price. Deng and Cheng found a positive relationship between ESG performance and stock market performance in their 2019 study [1]. Feng Panpan et al. pointed out in their study in 2024 that good ESG performance of enterprises can attract the attention of institutional investors and enhance the liquidity of stocks [2]. In 2023, Tian Peng proposed that investing in enterprises with excellent ESG performance may obtain excess returns by constructing the CAPM model, Fama-French three-factor model, and four-factor model including ESG factors [3]. At the same time, Dong Xianglan's research in 2023 and Liu Huihong and Zhang Zheyuan's research in 2023 show that improving the ESG performance of enterprises reduce the risk of stock price crash [4] and reduce stock price volatility [5]. However, due to differences in the assessment criteria adopted by different rating agencies, such differences may also have an impact on the stock market. In 2023, Liu Xiangqiang et al. found in their study based on ESG rating divergence of four different rating agencies that such divergence increased information asymmetry, had a noise effect, and significantly improved stock price synchronism [6].

From the perspective of enterprise operation, researchers generally believe that the ESG performance of enterprises and their information disclosure have a significant impact on enterprises. Hahn and Kuhnen (2013) reviewed 178 studies on corporate disclosure containing ESG information and concluded that corporate disclosure significantly enhanced information transparency, improved corporate image and reputation, and significantly enhanced employees' work enthusiasm, encouraging them to contribute more actively to the improvement of corporate business performance [7]. Xiao-hong dong and Sun Zhenghan (2023), inspection of ESG's relationship with management risk, the empirical results show that the enterprise good ESG performance can be increased by reducing information asymmetry and the attention of analysts to reduce the management risk [8]. In addition, Zhang et al. (2024) proposed that ESG performance can improve the efficiency of labor investment and prevent excessive or insufficient labor investment by easing financing constraints and stimulating employee innovation [9].

2.2. Influencing factors of corporate debt financing cost

Scholars globally concur that the expense associated with corporate debt financing is influenced by a multitude of elements. These encompass the financial health of the company, the overarching macroeconomic conditions and governmental policy directions, the integrity of corporate financial reporting and the transparency of accounting information, the corporate governance framework and the efficiency of operations, as well as the communication of non-financial data.

In 2020, the relevant guidance issued by the China Banking and Insurance Regulatory Commission emphasized that ESG factors should be considered in the approval process of bank loans. Different from state-owned enterprises, private enterprises can use guarantee effect to reduce debt cost by introducing state-owned capital through mergers and acquisitions [10]; Zhang (2020) found through investors' site visits that the frequency, scope and depth of investors' visits to enterprises were negatively correlated with the cost of corporate debt financing, especially in non-state-owned enterprises [11]; The research of Lin Zhonggao et al. (2017) found that enterprises with good internal control and corporate governance tend to have low operating risks and correspondingly reduce the cost of debt financing [12]; From the perspective of customer characteristics, Jiang Wei et al. (2017) found that there was a trend of first increasing and then decreasing between the scale of long-term loans and customer concentration [13]; Zheng Jianming et al. (2021) studied from the perspective of the characteristics of senior executives, and believed that the status of senior executives symbolized high moral standards and sense of responsibility, which could provide reputation guarantee for the solvency of enterprises, enhance the credibility of accounting information, and help reduce the cost of debt financing [14]; Wang et al. (2019) found that the risk information disclosed in the annual report of enterprises can reduce information asymmetry and reduce the loan cost by reducing the risk perception of banks [15]; Zhai et al. (2017) found in the tight monetary policy environment that high information disclosure quality and accounting transparency help enterprises to obtain more bank loans with lower cost [16]; However, when enterprises are faced with high litigation risk, creditors may demand higher borrowing interest rates for fear of asset loss or debt increase [17]. Ma et al. (2020) found in the study of Chinese enterprises that the increase of government debt will lead to the increase of corporate debt financing cost and the reduction of financing scale [18].

2.3. Literature comment

A synthesis of the current literature on ESG and the costs of corporate debt financing reveals that the notion of ESG performance is relatively recent, and there is a divergence of opinions within the academic sphere regarding its economic implications. A preponderance of research suggests that robust ESG performance can mitigate information asymmetries, diminish corporate risks, enhance operational efficiency, and consequently, boost the value of the enterprise. Concurrently, the bulk of the existing literature isolates the economic impacts of the E, S, and G components, with scant comprehensive analysis of their collective influence. Against this backdrop, this paper will conduct a review of both domestic and international scholarly literature to investigate the effects of ESG performance on the cost of corporate debt financing.

3. Theoretical basis and research hypothesis

3.1. Concept definition

3.1.1. ESG performance.

The acronym ESG stands for Environmental, Social, and Governance. Originating in the 1980s, the concept of ESG was prominently introduced in its entirety by the UN Global Compact through the 2004 report titled "Who Cares Wins." Since then, it has garnered significant attention worldwide. ESG serves as a suite of critical metrics for assessing a company's performance beyond financial metrics, with ESG performance being evaluated through a specific ESG rating system by assessment

agencies. This system takes into account a company's environmental conservation efforts, social responsibilities, and governance structures, thereby reflecting the actual effectiveness of a company's ESG initiatives. It is a key benchmark utilized by the global community to gauge the sustainability and green practices of businesses, typically represented by relevant rating indicators [19].

Internationally, ESG performance is mainly provided by third-party organizations such as MSCI ESG Research (MSCI ESG Rating) and S&P Dow Jones Indices; And ESG performance rating in China starts late, at present China ESG, its green ESG, club for au rating approaches such as sustainable development of ESG, embellish spirit ESG, they through different point of view, the potential impact of ESG performance measurement to determine the economic value of the enterprise.

3.1.2. Cost of corporate debt financing.

Referring to the research of Zhang Xinmin (2017) et al., the cost of corporate debt financing refers to all the expenses that enterprises need to bear in the process of debt financing, including the explicit costs paid to obtain external funds such as interest and related service fees, as well as some hidden costs that are not easily perceived [20]. The difference in these costs is mainly due to the information asymmetry between investors and borrowers, which may lead to the generation of risk premium. Companies end up bearing these costs in different forms, and together they constitute the cost of debt financing.

When constructing debt financing cost indicators, the academic community has adopted a variety of methods. From the perspective of cost (i.e., financing cost), some studies, such as Zheng (2013), used financial fees to represent financing cost [21]. At the same time, many researchers have adopted a more comprehensive measurement method. This includes separating out the interest expense from the financial expense, or combining the interest expense with the commission and other related expenses to arrive at the net financial expense. This method not only includes direct interest expenses, but also covers other expenses related to financing, which can more comprehensively reflect the net cost of the enterprise in the process of debt financing. When it comes to determining the denominator, scholars also have different choices. Some studies choose total debt or average annual debt as the denominator, which reflects the overall debt burden of a company. Other studies tend to use interest-bearing debt as the denominator, which focuses more on the portion of debt that incurs interest expense. In practice, other payables, long-term payables, lease liabilities, etc., may also contain interest components, which need to be considered in the calculation.

3.2. Theoretical basis

3.2.1. Sustainable development theory.

Sustainable development theory, as a holistic framework, encompasses a broad spectrum of areas including economic, social, and environmental dimensions. It underscores the importance of integrating environmental conservation and resource preservation within economic development to secure a sustainable future. In January 2023, the State Council Information Office of China published the “White Paper on China’s Green Development in the New Era,” which detailed the nation's green development philosophy and practices across eight thematic sections. Businesses, as pivotal market participants, hold an indispensable role in embodying the principles of “sustainable development” in their operations and strategies[22]. Major enterprises are actively responding to the policy call to achieve green transformation, from the traditional business method to the new mode of sustainable development, no longer simply pursue short-term economic benefits, but take a long-term view, strengthen the management and practice of sustainable development, actively practice the core concept of ESG, while promoting their long-term and stable development, And make substantial contributions to promoting the realization of the global sustainable development goals.

3.2.2. Asymmetric information theory.

According to the theory of information asymmetry, there are differences in the relevant interest information obtained by all kinds of people in the market economy. The more fully mastered the information, the more obvious the position advantage, while the information-poor people are often at a disadvantage[23]. In modern corporate governance, due to the separation of ownership and management rights between creditors and enterprises in corporate debt financing, there is a significant information asymmetry phenomenon, which constitutes the problem of adverse selection. Therefore, the regular release of detailed ESG information by enterprises can transform information resources into information assets, which can be used as a new tool to meet the needs of investors to a certain extent, help reduce information asymmetry and improve information transparency, so as to assist creditors to make more intelligent investment decisions. It provides a new possibility to reduce the extra cost caused by the principal-agent relationship.

3.2.3. Stakeholder theory.

According to the stakeholder theory, the importance of physical capital owners in enterprises is gradually declining, which strongly challenges the traditional idea that the ownership of enterprises is owned by individuals and institutions holding common stock[24]. Therefore, the development goal of enterprises should not only be limited to the maximization of shareholders' interests, but should balance and attach importance to the rights and interests of all stakeholders. The ESG performance as the sustainable development of the enterprise for the future trend of adaptability and commitment to the important business cards, with the requirements of the stakeholders are complementary to each other. With the popularization of ESG concept, in the context of green finance, financial institutions have a preference for allocating capital to companies that excel on ESG, whose financing conditions are easier to meet and the financing cost is lower. In the long run, conveying ESG performance information to creditors can better meet their demand for long-term operation indicators, thus reducing debt financing costs.

3.2.4. Signaling Theory.

Signaling theory states that in an environment with asymmetric information, firms will typically communicate their inside information to the market in three main ways: profit announcements, dividend policy, and financing announcements. In these ways, dividend policy is considered as a highly credible signal because it can be used as an indicator of the future value of the company, helping investors to assess the true value of the company more accurately. Trueman (1986) believed that the effect of signal transmission depends on the quality of the transmitter and the signal itself. If the trustworthiness of the transmitter is insufficient, it may send misleading information and deceive the receiver with "fraudulent" behavior [25]. Viewing from the lens of ESG performance, companies proactively share information to project an image of actively embracing their social responsibilities. This transparency aids in bolstering the company's reputation, consequently leading to a reduction in the costs associated with debt financing.

3.3. Hypotheses are proposed

3.3.1. The impact of ESG performance on corporate debt financing cost.

At present, the development of green finance in China is stepping into the "deep water period", and the issuance of green bonds has led the world for two consecutive years. It continues to make efforts in system improvement, product innovation and financing optimization, and has firm determination and clear direction in the field of ESG investment, aiming to promote the economic development to a more sustainable and environmentally friendly direction.

According to the existing research and theoretical basis, this paper ESG performance may on the impact of debt financing cost analysis is as follows: With the popularization of the concept of sustainable development, more relevant policies on green finance have been introduced at the national

level, and the impact of ESG performance on corporate debt financing is increasing, which has gradually become the focus of major financial institutions, thus favoring enterprises with better ESG performance and giving “clear rewards and punishments” to corporate debt financing [26]. In essence, superior ESG performance correlates with reduced debt financing costs for a company. From the vantage point of information asymmetry theory, robust information disclosure is pivotal for bridging informational gaps and mitigating the issue of information asymmetry. Enhancing the quality of information disclosure is instrumental in addressing the disparity in information between businesses and their creditors. ESG performance serves as a conduit for timely and effective communication, furnishing companies with a platform for high-quality information sharing, which assists creditors in gaining a deeper insight into the enterprise, thereby potentially lowering the debt financing costs. Furthermore, drawing on interest-related theories, a company can demonstrate its commitment to various stakeholders through its ESG performance, offering them a more comprehensive view of the business and, as a result, achieving a lower cost of debt financing.

Based on this, this paper makes the following hypothesis:

H1: ESG performance is significantly negatively correlated with Corporate debt financing cost.

3.3.2. The impact of ESG performance on Cost of Corporate Debt Financing under the moderating effect of ownership nature.

There are general studies suggest that China’s credit system exists in the “preference” ownership, state-owned enterprises are usually able to take advantage of the advantages it easier to get money from capital markets, while the non-state-owned enterprises face higher costs of debt financing. According to signaling theory, positive information released by the enterprise to outside market with confidence and thus increase the likelihood of resource acquisition and further reduce the cost of debt financing, non-state-owned enterprises to get more attention and support, through disclose more information to deliver a positive signal, the financing and investment opportunities to get more.

Building on this foundation, the present study formulates the following hypothesis:

H2: Non-state-owned enterprises experience a more pronounced impact of ESG performance on debt financing cost reduction compared to state-owned enterprises.

4. Research design

4.1. Sample selection and data sources

This study selects the listed companies in China's A-share market from 2009 to 2023 as the research objects, and obtains most of the required sample data mainly through the CSMAR database. As for the ESG performance data of enterprises, they mainly come from the ESG database of China Securities. It is worth adding that, compared with other evaluation systems, the ESG database of China Securities not only refers to the international authoritative ESG evaluation standards, but also considers the characteristics and information disclosure practices of Chinese listed companies. The database uses modern technical means such as natural language processing (NLP) technology and semantic analysis to ensure that the evaluation results are more in line with the specific needs of the Chinese market.

At the same time, the samples were screened as follows:

First, ST/*ST enterprises were excluded;

Second, eliminate listed companies in the financial industry;

Third, eliminate the observation values with missing data in the control variables;

Fourthly, the main continuous variables used were winsorized by 1% and 99%.

Finally, 26,507 unbalanced panel data observations were obtained.

4.2. Model construction and variable definition

In order to study the impact of ESG performance on Debt Financing Cost, this paper constructs the fixed effect regression model as follows:

$$\text{Debt Financing cost} = \beta_0 + \beta_1 \text{ESG}_{i,t} + \gamma \text{Controls}_{i,t} + \delta \text{Year}_t + \theta \text{Industry}_i + \varepsilon_{i,t} \quad (1)$$

Among them, the explained variable is Debt financing Cost. Considering the acquisition cost of data and the reflection of the overall cost of debt, this paper adopts the method of Yang and Zhang (2016) [27] and Lin and Ding (2017) [28], and uses the ratio of corporate financial expenses to total liabilities as the measurement index of debt financing cost., and measures the cost of debt financing by the ratio of corporate financial expenses to total liabilities. In order to avoid the impact of enterprises' own financial interest income, this study uniformly records the data with negative financial expenses as 0.

Explanatory variable ESG performance (ESG). Referring to the operation method of Gao et al. (2021), this paper quantifies the ESG score and information disclosure of enterprises through the ESG rating system of China Securities [29]. The rating system is divided into nine levels, from the lowest to the highest, corresponding to a score of 1-9. In order to avoid the error caused by the large difference between the debt financing cost and the original data of ESG rating score, the ESG performance is measured by the value obtained from the ESG rating score /100 of China Securities.

At the same time, corporate debt financing cost is affected by many factors (namely control variables, which are uniformly represented by Controls), which constitute the key consideration in this study. In order to ensure the accuracy of the results, avoid the influence of other variables on the dependent variable or interfere with the relationship between independent variable and dependent variable, leading to potential experimental error or deviation, this research through the comprehensive consideration of existing research results, the research goal and data availability, selected for control variable of this study are analyzed. Reference Li Guangzi (2009) [30], Zhou Jie tang (2017) [31] the test methods, choose the main control variables are as follows: Asset-liability ratio (Debt Ratio), business net cash flows (OCF), Profitability (Profitability), enterprise scale (Size) and Growth (Growth), the nature of the Property (Property), the proportion of the first largest shareholder (Top1), the joining together of two position (Duality), the actual control two rights separation rate (Power separation). The relevant definitions of the above variables are shown in Table 1.

Table 1. Variable names and meanings

Types of variables	Variable name	Variable symbol	Meaning of variable
Explained variable	Corporate debt financing costs	Debt financing cost	Finance costing/total assets
Explanatory variables	ESG performance	ESG	China Securities ESG rating score /100
Control variables	Enterprise size	Size	Ln (total assets at the end of the year)
	Growth	Growth	Operating income growth rate
	Asset-liability ratio	Debt ratio	Total liabilities/total assets at the end of the period
	Net cash flow from operations	OCF	Operating cash inflow - Operating cash outflow
	Profitability	Profitability	Total assets - current liabilities
	Nature of property rights	Property	If the actual controller of the enterprise is state-owned, it takes 1; otherwise, it takes 0
	Shareholding ratio of the largest shareholder	Top1	Number of shares held by the largest shareholder/number of shares held by all shareholders
	Two in one	Duality	Dual director and supervisor takes 1, otherwise 0
	The separation rate of the two rights of actual controllers	Power separation	The actual controller has the difference between control and ownership of the listed business

5. Empirical analysis

5.1. Descriptive statistics

Table 2 reports the results of descriptive statistics for all variables in Model (1).

Observations reveal that the debt financing cost for A-share listed companies in China ranges from a minimum of 0 to a maximum of 0.57, with an average of 0.021 and a standard deviation of 0.016. This indicates significant variance in debt financing costs across companies: some companies, due to higher perceived operational and financial risks, are inclined to engage in debt financing at a higher cost; others might finance through internal resources, such as retained earnings, thus avoiding additional financing expenses. These findings align with the prevailing market conditions characterized by the challenges and high costs associated with securing financing.

The ESG performance metrics show a maximum value of 0.078, a minimum of 0.01, an average of 0.041, and a standard deviation of 0.009. The presence of substantial outliers is evident, with the average significantly lower than the maximum. This suggests that a minority of A-share listed companies in China exhibit strong ESG performance, while the majority demonstrate a lack of comprehensive ESG awareness, indicating considerable potential for enhancement in their ESG practices.

Among the control variables, there are great differences in the Growth, Debt Ratio and operating cash flow (OCF) of different enterprises, which indicates that the performance of different enterprises in future development, profitability and cash flow stock of business activities is inconsistent.

In general, the stability of the sample data is relatively high, with good representativeness.

Table 2. Descriptive statistical results

Variables	N	Average	Std.Dev.	Min	Max
Debt financing cost	26506	0.021	0.016	0	0.57
ESG	26506	0.041	0.009	0.01	0.078
Size	26506	2.203e+10	1.039e+11	54000000	2.900e+12
Growth	26506	0.152	0.542	-0.91	41.46
Debt ratio	26506	0.495	0.181	0.027	0.998
OCF	26506	1.254e+09	1.001e+10	-4.300e+10	4.600e+11
Profitability	26506	0.024	0.08	-2.83	0.79
Property	26410	0.41	0.492	0	1
Top1	26426	34.043	14.898	1.84	89.99
Duality	25807	0.262	0.44	0	1
Power separation	26023	4.805	7.775	-80.582	60.323

5.2. Correlation analysis

Table 3 reports the correlation analysis results of all variables in Model (1).

According to the correlation analysis among the variables, the correlation coefficient between corporate financing cost and ESG performance stands at -0.141, which is statistically significant at the 10% level. This suggests an inverse relationship between ESG performance and the debt financing cost for A-share listed companies in China. In essence, companies with superior ESG performance tend to incur lower debt financing costs.

For control variables, corporate Debt financing cost is positively correlated with Debt Ratio, Property and Power separation rate of actual controller. When the above three indexes are high, creditors should take the initiative to reduce their expectations of corporate operating conditions. Net operating cash flow (OCF), Profitability (Profitability), enterprise Size (Size), Growth (Growth), the largest shareholder's shareholding ratio (Top1), Duality (Duality) will promote the decrease of corporate debt financing cost.

The analysis indicates that, with the exception of the correlation coefficient between enterprise Size and operating net cash flow (OCF), which is influenced by scale effects and reaches 0.745, the correlation coefficients for all other variables are below 0.5, falling within an acceptable range for interpretation. This suggests that there is no severe multicollinearity among the key variables under consideration.

In addition, considering the limitations of correlation analysis, such as misunderstanding of causality and ignoring of nonlinear relationship, this study needs to combine regression analysis to obtain deeper and more convincing results.

Table 3. Correlation analysis

Variables	Debt financing cost	ESG	Size	Growth	Debt ratio	OCF	Profitability	Property	Top1	Duality	Power separation
Debt financing cost	1.000										
ESG	-0.141* (0.000)	1.000									
Size	-0.059* (0.000)	0.159* (0.000)	1.000								
Growth	-0.102* (0.000)	0.024* (0.000)	-0.010 (0.119)	1.000							
Debt ratio	0.072* (0.000)	- 0.039* (0.000)	0.144* (0.000)	- 0.019* (0.002)	1.000						
OCF	-0.019* (0.002)	0.104* (0.000)	0.745* (0.000)	- 0.014* (0.025)	0.032* (0.000)	1.000					
Profitability	-0.125* (0.000)	0.157* (0.000)	0.016* (0.010)	0.147* (0.000)	- 0.261* (0.000)	0.041* (0.000)	1.000				
Property	0.013* (0.041)	0.069* (0.000)	0.153* (0.000)	- 0.074* (0.000)	0.272* (0.000)	0.098* (0.000)	-0.016* (0.009)	1.000			
Top1	-0.046* (0.000)	0.093* (0.000)	0.174* (0.000)	- 0.013* (0.035)	0.078* (0.000)	0.149* (0.000)	0.123* (0.000)	0.241* (0.000)	1.000		
Duality	-0.026* (0.000)	- 0.014* (0.023)	- 0.061* (0.000)	0.033* (0.000)	- 0.120* (0.000)	- 0.041* (0.000)	0.002 (0.778)	-0.311* (0.000)	- 0.087* (0.000)	1.000	
Power separation	0.024* (0.000)	- 0.017* (0.008)	- 0.030* (0.000)	-0.007 (0.278)	0.031* (0.000)	- 0.021* (0.001)	0.033* (0.000)	-0.059* (0.000)	0.142* (0.000)	- 0.055* (0.000)	1.000

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively; Robust t values adjusted for heteroscedasticity are in parentheses.

5.3. Multi-collinearity analysis

Table 4 reports the results of the multicollinearity test for the control variables in Model (1).

To diagnose whether there is multicollinearity among the variables in the model, this study conducts variance inflation factor (VIF) test on both the explanatory and control variables incorporated in the model. The test results, as depicted in Table 4, reveal that all variables have VIF values below the threshold of 5, successfully passing the test at a 1% significance level. This signifies the absence of multicollinearity issues. Consequently, the study opts to proceed with a fixed effects regression model for further analysis.

Table 4. Results of multicollinearity test

Variable	VIF	1/VIF
ESG	1.06	0.944910
Size	2.37	0.421601
Growth	1.04	0.963009
Debt ratio	1.21	0.829576
OCF	2.27	0.449854
Profitability	1.15	0.866763
property	1.28	0.783736
Top1	1.13	0.882039
Duality	1.12	0.895411
Power separation	1.04	0.959150
Mean VIF	1.37	

5.4. Hausman test

Table 5 reports the results of the Hausman test for Model (1).

In order to determine the research model, this paper conducts Hausman test on the explanatory variables and control variables in the model. According to the results in Table 5, the statistic of Hausman test is 120.52, corresponding P value is 0.0000, and the test result is statistically significant at the 1% significance level, indicating that the fixed effect model is a more appropriate choice. Therefore, this paper decides to use the fixed effect regression model for subsequent analysis.

Table 5. Hausman test results

	(b) fe	(B) re	(b-B) Difference	sqrt (diag(V _b -V _B)) S
ESG	-0.1079322	-0.1369738	0.0290416	0.0046744
Size	-7.46e-15	-9.37e-15	1.92e-15	9.74e-16
Growth	-0.0034731	-0.0033218	-0.0001514	-0.0000316
Debt Ratio	0.0079186	0.0062926	0.001626	0.0004444
OCF	3.11e-14	4.05e-14	-9.39e-15	1.69e-14
Profitability	-0.13091	-0.0132733	0.0001823	0.0003743
property	0.0003316	-0.0000208	0.0003524	0.0004155
Top1	0.0000874	0.000024	0.0000634	8.27e-06
Duality	-0.0000737	-0.0001823	0.0001085	0.0001348
Power Separation	-0.0000324	-2.13e-06	-0.0000301	0.0000109
Hausman test statistic			120.52	
The p-value of the Hausman test			0.0000	

5.5. Regression analysis

Table 6 reports the results of the main regression analysis for all variables in Model (1).

In the analysis, Column (1) presents the regression outcomes excluding the primary explanatory variables; Column (2) introduces the key explanatory variable, ESG performance. The regression coefficient for ESG performance, as per the table, is -0.108 , significant at the 1% level. This suggests that enhancing a company's ESG performance is significantly associated with a reduction in the debt financing costs for A-share listed companies in China.

This regression analysis delves into the potential obstacles that A-share listed companies in China might face in their ESG practices, examining these through the lens of debt financing costs, and reveals that in the context of green finance, creditors should recognize that ESG performance helps enterprises identify and control environmental, social and governance risks, reduce potential losses, achieve long-term sustainable development, and promote corporate green innovation. Thus, more value is created, which supports Hypothesis H1.

Table 6. Results of main regression analysis

	(1) Debt financing cost	(2) Debt financing cost
ESG		-0.108*** (-8.591)
Size	-0.000*** (-3.924)	-0.000*** (-3.452)
Growth	-0.004*** (-19.819)	-0.003*** (-19.635)
Debt Ratio	0.009*** (9.799)	0.008*** (9.110)
OCF	0.000 (0.932)	0.000 (1.117)
Profitability	-0.013*** (-10.223)	-0.013*** (-10.154)
Property	0.000 (0.607)	0.000 (0.590)
Top1	0.000*** (6.520)	0.000*** (6.693)
Duality	-0.000 (-0.183)	-0.000 (-0.249)
Power Separation	-0.000 (-1.590)	-0.000 (-1.569)
_cons	0.015*** (22.047)	0.020*** (22.671)
N	25336	25336
R ²	0.035	0.039
F	88.239	87.062

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively; Robust t values adjusted for heteroscedasticity are in parentheses.

5.6. Robustness test

5.6.1. Adjust the time window.

Table 7 reports the regression analysis results of all variables after adjusting the time window.

Following the issuance of the "Guidance on Building a Green Financial System" in August 2016, China has pioneered the establishment of a policy framework for green finance, becoming the first economy globally to do so. In 2018, the China Securities Regulatory Commission (CSRC) updated the "Listed Company Governance Code," incorporating provisions related to ESG performance, marking a pivotal moment for ESG practices among A-share listed companies. To further assess the model's robustness, this study adjusts the sample data timeframe to 2016-2023, aligning with the

regression analysis approach from the previous section, and conducts tests based on Model (1). The outcomes of the regression are presented in Table 7.

It can be concluded that the regression coefficient of explanatory variable ESG performance is -0.119, which is significant at the level of 1%, indicating that the improvement of ESG performance of enterprises from 2016 to 2023 is still significant with the debt financing cost of China's A-share listed enterprises, which is consistent with Hypothesis H1.

Table 7. Regression analysis results after adjusting the time window

	(1) Debt financing cost	(2) Debt financing cost
ESG		-0.119*** (-7.664)
Size	-0.000*** (-4.204)	-0.000*** (-3.956)
Growth	-0.002*** (-11.390)	-0.002*** (-11.254)
Debt ratio	0.001 (0.504)	-0.000 (-0.131)
OCF	-0.000 (-0.408)	-0.000 (-0.335)
Profitability	-0.015*** (-10.048)	-0.015*** (-10.108)
Property	-0.001*** (-1.814)	-0.001*** (-1.909)
Top1	0.000*** (2.792)	0.000*** (2.599)
Duality	-0.000 (-0.777)	-0.000 (-0.804)
Power separation	-0.000* (-1.690)	-0.000* (-1.709)
_cons	0.019*** (17.857)	0.024*** (19.126)
N	16837	16837
R ²	0.023	0.027
F	34.864	37.387

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively; Robust t values adjusted for heteroscedasticity are in parentheses.

5.6.2. Replace explanatory variables.

Table 8 reports the results of regression analysis after replacing explanatory variables.

In the robustness test, referring to the practice of Guo and Wang (2023), this paper chooses the total ESG score published in Bloomberg database as the explanatory variable, and the analysis method of other data remains unchanged [32]. The data obtained are tested according to Model (1), and the outcomes are depicted in Table 8.

The regression analysis yields a coefficient of -0.024 for the explanatory variable ESG performance, which is significant at the 1% level, thereby providing further validation for Hypothesis H1, indicating that the better the enterprise ESG performance is, the lower the debt financing cost is, and the previous conclusion is robust.

Table 8. Regression analysis results after replacing explanatory variables

	(1) Debt financing cost	(2) Debt financing cost
ESG_Bloom berg		-0.024*** (-12.131)
Size	-0.000*** (-3.197)	-0.000 (-0.219)
Growth	-0.004*** (-12.478)	-0.004*** (-13.258)
Debt ratio	0.015*** (9.624)	0.015*** (9.457)
OCF	0.000 (1.634)	0.000*** (2.927)
Profitability	-0.015*** (-5.326)	-0.015*** (-5.574)
Property	0.002* (1.698)	0.002* (1.686)
Top1	0.000** (2.025)	-0.000 (-0.795)
Duality	0.001 (1.137)	0.001 (1.300)
Power separation	-0.000** (-2.011)	-0.000 (-1.461)
_cons	0.013*** (9.849)	0.022*** (14.636)
N	7461	7461
R ²	0.057	0.078
F	42.061	53.450

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively; Robust t values adjusted for heteroscedasticity are in parentheses.

5.6.3. Instrumental variable method.

Table 9 reports the test results of Model (1) based on the instrumental variable method.

Recognizing that companies within the same year, province, and industry often experience similar policy environments, and acknowledging that an enterprise's ESG performance could be influenced by the performance fluctuations of other companies in the same geographical and industrial sectors, leading to a certain degree of consistency in ESG performance, this paper suggests that the ESG performance of these companies reflects, to an extent, the characteristics of their own operations. Additionally, considering the absence of a direct link between the average ESG performance of other firms in the same year, province, and industry and the debt financing cost of a given company, this study adopts the instrumental variable approach as described by Gao et al. (2021). Specifically, the average ESG performance of other companies in the same year, province, and industry is chosen as the instrumental variable (ESG_IV). Subsequently, a two-stage least squares regression (2SLS) is applied to Model (1) to account for potential endogeneity issues [33].

As per the table, in the initial phase of the regression, the instrumental variable ESG_IV is significantly associated with ESG performance at the 1% level. In the subsequent phase of regression, ESG performance continues to exhibit a significant reduction in the debt financing cost of enterprises at the 1% level. This affirms the robustness of the findings presented in this paper.

Table 9. Test results of instrumental variable method

	Stage 1 ESG	Stage 2 Debt financing cost
ESG_IV	0.863*** (119.361)	
ESG		-0.111*** (-7.996)
Size	0.000*** (5.879)	-0.000*** (-3.108)
Growth	0.000 (0.668)	-0.003*** (-17.490)
Debt ratio	-0.003*** (-7.286)	0.007 *** (7.707)
OCF	0.000* (1.790)	0.000 (1.264)
Profitability	0.001** (2.479)	-0.014*** (-9.881)
Property	0.000 (1.169)	0.000 (0.719)
Top1	-0.000 (-1.200)	0.000*** (6.691)
Duality	-0.000 (-1.095)	-0.000 (-0.264)
Power separation	0.000 (0.788)	-0.000 (-1.557)
_cons	0.042*** (138.129)	0.020*** (20.778)
N	20963	20963
R ²	0.457	0.040
F	1467.902	71.895

Note: ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively; Robust t values adjusted for heteroscedasticity are in parentheses.

5.7. Heterogeneity test

Table 10 reports the heterogeneity test results of all variables in Model (1). Among them, column (1) is non-state-owned enterprises; Column (2) is for soes.

In line with Hypothesis H2, the study examines the heterogeneity of enterprises based on their property attributes, distinguishing between state-owned enterprises (SOEs) and non-state-owned enterprises. The findings indicate a significant and negative correlation between ESG performance and debt financing costs across both types of enterprises. Specifically, the regression coefficient for non-state-owned enterprises is -0.127, whereas for SOEs it is -0.075. The p-value from the test comparing the coefficients of the two groups is 0.000, signifying a statistically significant difference. This suggests that the inverse relationship between ESG performance and the debt financing costs is more pronounced in non-state-owned enterprises compared to SOEs, thereby corroborating Hypothesis H2.

Table 10. Results of heterogeneity test

	(1) Debt financing cost (non-state-owned enterprises)	(2) Debt financing cost (state-owned enterprise)
ESG	-0.127*** (-6.099)	-0.075*** (-3.171)
Size	-0.000** (-2.019)	-0.000*** (-2.634)
Growth	-0.003** (-2.552)	-0.006*** (-6.047)
Debt ratio	0.003 (1.351)	0.016*** (6.038)
OCF	0.000 (0.132)	0.000** (2.409)
Profitability	-0.012** (-2.017)	-0.016*** (-3.882)
Top1	0.000** (2.281)	0.000** (2.201)
Duality	-0.000 (-0.543)	-0.000 (-0.098)
Power separation	-0.000 (-0.966)	-0.000 (-0.327)
_cons	0.024*** (13.479)	0.014*** (6.201)
N	15159	10177
R2	0.032	0.067
F		
Experience the P value	0.000***	

Note: ***, ** and * respectively in 1%, 5% and 10% significance level; Robust t values adjusted for heteroscedasticity are in parentheses.

6. Conclusions and recommendations

The advancement of green finance is pivotal for steering the global economy towards a sustainable trajectory. It addresses environmental challenges while presenting novel avenues for growth to financial entities and investors. ESG investment, a key facet of green finance, has garnered widespread acceptance among businesses. This research empirically explores the correlation between ESG performance and the cost of corporate debt financing, revealing that within the green finance paradigm, enhanced ESG performance correlates with reduced corporate debt financing costs. In essence, ESG performance fortifies a company's sustainability and attracts additional investment, lowers internal financing expenses, and fosters long-term value expansion and refined risk management, all while advancing environmental conservation and societal advancement. Drawing from this analysis, the paper suggests that companies should embed ESG principles into their strategic frameworks and operations, prioritize the identification and mitigation of ESG-related risks, and ensure that business decisions align with sustainable development objectives. This approach not only underscores a company's dedication to social responsibility and sustainable practices but also aids in propelling the transformation and enhancement of China's economic landscape. Looking ahead, this will solidify the foundation for a green, low-carbon, and circular modern economic system, empowering China to play a more pivotal role in the global sustainable development narrative.

References

- [1] Deng X, Cheng X. Can ESG indices improve the enterprises' stock market. performance? - An empirical study from China [J]. *Journal of Sustainability*, 2019, 11 (17): 4765.
- [2] Feng Pan, climbing PangJiangWu Qin Xinhui. ESG performance research on the influence of stock liquidity -- based on the perspective of investor attention and emotion [J]. *The financial theory and practice*, 2024, (01): 79 - 89.
- [3] peng tien. Corporate ESG performance research on the influence of the stock investment income - based on China's a-share listed companies' empirical evidence [J]. *Productivity Research*, 2023 (12): 135 - 140.
- [4] Dong Xianglan, Deng Jianhong, Jiang Xi, et al. [4] [DONG X L, DENG J H, Jiang X, et al. ESG performance and stock price crash risk: Moderating effect analysis based on financing constraints [J]. *Journal of Financial Theory and Practice*, 2023 (09): 98 - 108.
- [5] Liu Huihong, chang source.LIU H H, Zhang Z Y. The impact of ESG performance, innovation efficiency and stock price volatility: based on A-share listed companies [J]. *Wuhan financial*, 2023 (02): 37 - 43 + 64.
- [6] Liu Xiangqiang, Yang Qingqing, Hu Jun. ESG rating divergence and stock price synchronism [J]. *China Soft Science*, 2023 (08): 108 - 120.
- [7] Hahn R, Kuhnen m. Determinants of sustainability reporting: A review of results, trends, theory, and opportunities in an expanding field of research [J]. *Journal of cleaner production*, 2013, 59: 5 - 21.
- [8] xiao-hong dong, Sun Zhenghan. The hook or self-defeating: ESG performance can reduce the business risk? *Journal of Central University of Finance and Economics*, 2023 (07): 57 - 67.
- [9] Zhang Zena Xia Yujie, snow. Can assign or negative energy: ESG performance and enterprise labor investment efficiency [J/OL]. *Foreign economic and management*, 1 - 17. <https://doi.org/10.16538/j.cnki.fem.20240120.201>.
- [10] ai-ling pan, livid, Janice. Cross ownership of mergers and acquisitions, institutional environment and private enterprise debt financing cost [J]. *Journal of accounting research*, 2019 (05): 3 - 10.
- [11] Zhang Y. Property rights, investors' site visits and corporate debt financing costs [J]. *Journal of guangdong university of finance and economics*, 2020, 35 (4): 72 - 86.
- [12] Lin, Z. & Ding, Maohuan. Defect repair and its internal control of enterprise debt financing cost - based on the influence of internal control Regulation of empirical research of the perspective of institutional change [J]. *Journal of accounting research*, 2017 (04): 73 - 80.
- [13] Jiang Wei, Di Lulu, Peng Chen. Does customer concentration affect long-term bank loans? Empirical evidence from Chinese listed companies *Nankai Business Review*, 2017, 20 (02): 71 - 80.
- [14] Zheng J M, Sun S L, Li J T. [14] The cultural background of senior executives and the cost of corporate debt: from the perspective of model worker culture [J]. *Accounting Research*, 2021 (03): 137 - 145.
- [15] Wang Xiongyuan, used to worship. WANG X Y, Zeng J. Annual report risk information disclosure and bank lending rate [J]. *Journal of Financial Research*, 2019 (01): 54 - 71.
- [16] ZHAI G Y, ZHANG B C. Monetary policy, corporate debt financing and accounting information transparency - based on 2004-2014, China Empirical analysis of listed companies' data [J]. *Research of International Finance*, 2017(05): 36 - 45.
- [17] Liu, H., Zhang, J. & Zhou, J. Litigation risk, legal environment and corporate debt financing costs [J]. *Nankai management review*, 2016, 19 (05): 16 - 27.
- [18] The horse tree, huaxia, Han Yunhong. Local government debt how to squeeze out the entity enterprise credit financing? - industrial companies from China In microscopic evidence [J]. *Journal of international financial research*, 2020 (05): 3 - 13.
- [19] Qiu Muyuan, Yin Hong. ESG under the background of ecological civilization construction enterprises and the cost of financing [J]. *Journal of quantitative technical economics*, 2019, 36 (03): 108 - 123.
- [20] Zhang xinming, ting-ting zhang, Chen Deqiu. Industrial policy, financing constraints, and business investment efficiency [J]. *Journal of accounting research*, 2017, (4): 12-18 + 95.
- [21] lee, zhong-gao Lin, Daisy. Monetary policy and the quality of internal control and the cost of debt financing [J]. *Journal of contemporary finance and economics*, 2013, (09): 118 - 129.
- [22] Xiong Zixuan.Study on the impact of ESG Performance on Debt Financing Cost [D]. Master's Thesis, Qilu University of Technology, 2024.
- [23] Akerlof G A. The Market for "Lemons": Quality Uncertainty and the Market Mechanism[J]. *The Quarterly Journal of Economic*, 1970, 84 (3): 488 - 500.
- [24] wing-keung cheung, li-gen yao. Engineering ethics [C]. Beijing: higher education press, 2014.
- [25] Trueman B. Why do Managers Voluntarily Release Earnings Forecasts? [J]. *Journal of Accounting and Economics*, 1986, 8 (01): 53 - 71.

- [26] Wu Hongyi, James Addison Ingle. Green credit policy to the enterprise debt financing "reward" and "punishment": based on the effects of the quasi-natural experiment evaluation [J]. Contemporary finance and economics, 2021 (2): 49 - 62.
- [27] Changhui Yang, Zhang Keli. [27] [Yang C H, Zhang K L. Research on private enterprise debt financing cost: Based on the dual perspective of interest rate liberalization and accounting conservatism [J]. Chinese Journal of Management Science, 2016 (S1): 405 - 412.
- [28] Zhong-gao Lin, Ding Maohuan. Internal control defect and its repair effect on corporate debt financing costs, based on the research on internal control regulation perspective of institutional change [J]. Accounting research, 2017 (4): 73 - 80.
- [29] Gao Jie Ying, Chu Dong Xiao Lian Yong Hui, Zheng Jun. Can ESG performance improve corporate investment efficiency? [J]. Journal of securities market leader, 2021, (11): 24 - 34 + 72.
- [30] Li Guangzi Liu Li. [30] [Li G Z, Liu L. Journal of Financial Research, 2009, (12): 137 - 150.
- [31] Zhou Jie don, Ma Zhi Ming Wu Liansheng. Senior academic experience and corporate debt financing costs [J]. Journal of economic research, 2017 (7): 169 - 183.
- [32] Guo M J & Wang J Q. Research on the relationship among ESG performance, media supervision and financing cost of heavy polluting enterprises [J]. Scientific Decision, 2023 (11): 1 - 20.
- [33] Gao Jie Ying, Chu Dong Xiao Lian Yong Hui, Zheng Jun. ESG performance can improve the efficiency of corporate investment? [J]. Journal of securities market leader, 2021, (11): 24 - 34 + 72.