The Impact of Environmental, Social, Governance Performance of Listed Companies on Financing Costs from a Dynamic Perspective

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Abstract. Based on a dynamic perspective, this paper analyzes the impact of listed companies' Environmental, Social, Governance (ESG) performance on corporate financing costs, focusing on solving the problem of how companies can improve ESG to more significantly reduce financing costs. The dynamic perspective in this paper refers to two types of dynamic attributes that characterize ESG from a time dimension: one is the annual improvement rate, and the other is the intra-year volatility (based on the variance of quarterly ratings). This paper found that for every 1 unit increase in the ESG improvement speed (ΔESG), the debt financing cost was significantly reduced by 0.2% ($p<0.01$), while for every 1 unit increase in the ESG volatility (σESG) over a year, the financing cost increased by 0.3% ($p<0.01$). Concurrently, the negative impact of ESG ratings on financing costs has a threshold of 4.044 in the Huazheng nine-level system. The research significance of this paper lies in revealing the mechanism by which ESG affects financing costs: the faster the ESG improvement, the more significant the reduction in financing costs; high ESG volatility within the year will generate a financing premium; at the same time, there is a threshold for the impact of ESG ratings on financing costs. Accordingly, this paper recommends that firms prioritize sustained, low volatility ESG upgrades and strive to cross—and remain above—the 4.044 threshold.

Keywords: Corporate financing costs, dynamic perspective, threshold effect.

1. Introduction

Against the backdrop of the continued deepening of dual carbon and green finance, corporate Environmental, Social, Governance (ESG) performance has become an important basis for capital market pricing and directly affects debt financing costs [1]. Existing studies have generally found that the absolute level of ESG is significantly negatively correlated with financing costs, mainly through alleviating information asymmetry, reducing agency costs and financing constraints [2]. However, this relationship is not linear and is heterogeneous: some literature suggests that it is inverted U-shaped – in the early stages of improvement, compliance and disclosure expenditures may first increase costs; Once a critical threshold is crossed, risk recognition and reputational gains dominate, and financing costs decline [3]. The effects also differ markedly by industry and ownership; non-state-owned firms and non heavily polluting industries tend to exhibit stronger cost-reducing effects of ESG [4].

Existing research still has two shortcomings: First, it often measures ESG levels from a static perspective, ignoring its dynamic nature, namely, the independent information and possible penalty effects contained in the speed of improvement (ΔESG) and process stability (σESG). Second, there is a general default of linear or quasi-linear settings, without systematically identifying when and at what level ESG improvements can be translated into a significant reduction in financing costs, and the potential threshold effect lacks quantification.

To address the above gaps, this article constructs an ESG dynamic analysis framework, focusing on how to optimize the ESG improvement path to achieve the optimal reduction in financing costs: using annual rating changes to characterize speed to reflect the execution strength and management efficiency of sustainable strategies. Stability is measured by intra-year fluctuations to reflect management consistency and resilience to shocks; threshold regression is introduced to identify key rating critical points and compare the marginal effects of ESG improvements above and below the

threshold. In theory, this paper incorporates the speed and stability of ESG into credit pricing, enriching the explanation of the mechanism by which non-financial information affects debt costs through risk premium [5]. In practice, it provides an operational path for issuers and creditors: issuers should strike a balance between continuous and verifiable improvement and steady progress with low volatility, and pay attention to the cost-benefit of crossing key thresholds; creditors and regulators can introduce ESG indicators that are sensitive to dynamics and stability in pricing and disclosure to improve the identification of long-term sustainable performance and the efficiency of resource allocation [6].

Based on the above analysis, this paper proposes the following testable hypotheses: H1 (Dynamic Effect): The speed and volatility of a company's ESG performance have a significant impact on debt financing costs—the faster the ESG improvement, the lower the financing costs; higher within-year ESG volatility increases financing costs. H2 (Threshold effect): the cost-reducing impact of ESG improvement is subject to thresholds—below the critical point, the marginal cost reduction effect is stronger.

2. Research Design

2.1. Sample Selection and Data Sources

This paper selects the data of A-share listed companies as samples and performs the following processing: excluding companies in the financial industry, all ST or ST* types, and companies with serious data missing. The data are primarily drawn from Wind and the China Stock Market & Accounting Research (CSMAR) database.

2.2. Variable Definitions

This paper draws on the research of Lin and Ding and uses the proportion of corporate financial expenses to total liabilities at the end of the period to calculate debt financing costs to reflect corporate financing costs [7]. The Huazheng ESG ratings: C, CC, CCC, B, BB, BBB, A, AA, and AAA are counted as 1-9 respectively, and the average of the ratings in the four quarters of a year is taken as the ESG rating for that year. The ESG change is calculated by the annual ESG change, and the ESG volatility is expressed by calculating the variance of the ratings in the four quarters of each year. When controlling for variables, the variable definitions in this paper are shown in Table 1: Enterprise size (Size), debt-to-asset ratio (Lev), profitability (ROA), board size (BS), and proportion of independent directors (IDR) are selected as control variables, and year and individual fixed effects are controlled.

2.3. Model Building

This paper constructs the following regression model to analyze the impact of annual changes in ESG ratings and ESG rating volatility on financing costs:

$$Cof_{i\,t}=\alpha_i+\beta_1\Delta ESG_{i,t}+\gamma X_{i,t}+\delta_t+\varepsilon_{i,t} \quad (1)$$

$$Cof_{i\,t}=\alpha_i+\beta_2\Delta ESG_{i,t}+\gamma X_{i,t}+\delta_t+\varepsilon_{i,t} \quad (2)$$

Furthermore, to analyze the threshold at which ESG ratings affect financing costs, this paper draws on Hansen panel threshold regression to construct the following model:

$$Cof_{i,t}=\alpha_i+\beta_1 ESG_{i,t}+\gamma X_{i,t}+\varepsilon_{i,t}\ \ ESG_{i,t}\le\gamma \quad (3)$$

$$Cof_{i,t}=\alpha_i+\beta_2 ESG_{i,t}+\gamma X_{i,t}+\varepsilon_{i,t} ESG_{i,t}>\gamma \quad (4)$$

Among them, α_i is the control individual fixed effect, δ_t is the control year fixed effect, and $X_{i,t}$ is the control variable.

3. The Impact of Annual Changes in Ratings on Financing Costs

Table 1. Variable definitions

Variable type	Variable name	Variable symbol	Variable meaning
Dependent variable	Cost of debt financing	Cof	The proportion of corporate financial expenses to total liabilities at the end of the period
Explanatory variables	ESG rating	ESG	Corporate ESG ratings (quarterly average)
	Annual change in ESG	ΔESG	ESG annual change
	ESG volatility	σESG	Variance of ESG ratings across the four quarters of each year
Control variables	Enterprise scale	Size	The natural logarithm of the company's total assets at the end of the period
	debt-to-asset ratio	Lev	Total liabilities/Total assets
	Profitability	ROA	Ratio of net profit to total assets at the end of the period
	Board size	Bs	Number of directors
	Proportion of independent directors	IDR	The proportion of independent directors to the total number of directors
	Year	Year	Controlling for year fixed effects
	individual	Code	Controlling for individual fixed effects

First, this paper conducts a descriptive statistical analysis on the samples. The statistical results are shown in Table 2. There are 40,665 valid data points in total [8]. The average annual change in corporate ESG ratings (desg) is close to 0, indicating that the overall ESG ratings of the companies in the sample change little each year. However, the maximum annual change in ESG decreased by 4.25, and the overall standard deviation was 1.009, indicating that there were large differences among the companies in the sample, with some companies experiencing small changes in ESG ratings and some companies experiencing large changes each year.

As can be seen from the first row of Table 3, the annual change in a company's ESG rating has a significant negative impact on debt financing costs; that is, the more the company's ESG rating increases each year, the more obvious the reduction in financing costs. In addition, profitability, debt-to-asset ratio, enterprise size, and board size also have an impact on debt financing costs.

4. The Impact of ESG Volatility on Financing Costs

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
code	40665	307436.46	274422.93	2	873527
year	40665	2017.766	3.93	2010	2023
size	40665	22.24	1.363	13.076	29.019
idr	40665	.377	.056	0	1
roa	40665	.031	.632	-30.303	110
lev	40665	.45	.984	-.195	178.345
bs	40665	8.472	1.689	0	21
cof1	40665	.005	.099	-2.455	14.793
desg	40665	-.001	.623	-4.25	2.75

Table 3. Regression results—annual change in ESG ratings

cof1	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
desg	-.002	0	-4.40	0.000	-.003	-.001	***
size	.005	0	13.75	0.000	.004	.006	***
idr	.001	.006	0.16	0.875	-.011	.012	
roa	.003	.002	1.36	0.174	-.001	.006	
lev	.005	.004	1.36	0.172	-.002	.012	
bs	.001	0	4.96	0.000	.001	.001	***
Constant	-.113	.007	-15.47	0.000	-.127	-.098	***

As shown in Table 4, the sample has a total of 19,235 valid data items, and the average value of corporate ESG volatility (vol) is 0.238, indicating that the ESG levels of most companies in the sample are relatively stable throughout the year, but the maximum value is 2.066, and the standard deviation is 0.305, indicating that some companies have large fluctuations.

As can be seen from the first row of Table 5, the annual volatility of corporate ESG ratings has a significant positive impact on debt financing costs, that is, the higher the ESG volatility, the higher the financing cost.

5. The Threshold Effect of ESG Ratings on Financing Costs

The model uses a grid search method to determine the optimal threshold value. The selection criterion is to minimize the residual sum of squares (RSS) of the model. The threshold is finally determined to be 4.0440: As shown in Figure 1, the horizontal axis represents the candidate threshold values, and the vertical axis represents the corresponding residual sum of squares (RSS). The blue curve exhibits a distinct U-shaped characteristic, with the minimum point (the green dashed line) representing the optimal threshold estimator. The convexity of the RSS function indicates that the threshold estimation is robust [9].

Table 4. Descriptive statistics analysis - ESG volatility

Variable	Obs	Mean	Std. Dev.	Min	Max
code	19235	339519.49	272422.4	2	873726
year	19235	2020.785	1.697	2018	2023
size	19235	22.486	1.342	18.776	28.697
idr	19235	.379	.056	.143	.8
roa	19235	.029	.086	-2.077	.789
lev	19234	.437	.19	.014	1.797
bs	19235	8.333	1.619	4	18
cof1	19235	.007	.031	-.783	.451
vol	19235	.238	.305	0	2.066

Table 5. Regression results – ESG volatility

cof1	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
vol	.003	.001	4.47	0.000	.002	.004	***
size	-.002	0	-9.80	0.000	-.002	-.001	***
idr	.003	.004	0.86	0.392	-.004	.011	
roa	-.016	.004	-3.76	0.000	-.024	-.007	***
lev	.069	.002	34.46	0.000	.066	.073	***
bs	.001	0	4.01	0.000	0	.001	***
Constant	.006	.003	1.98	0.048	0	.012	**

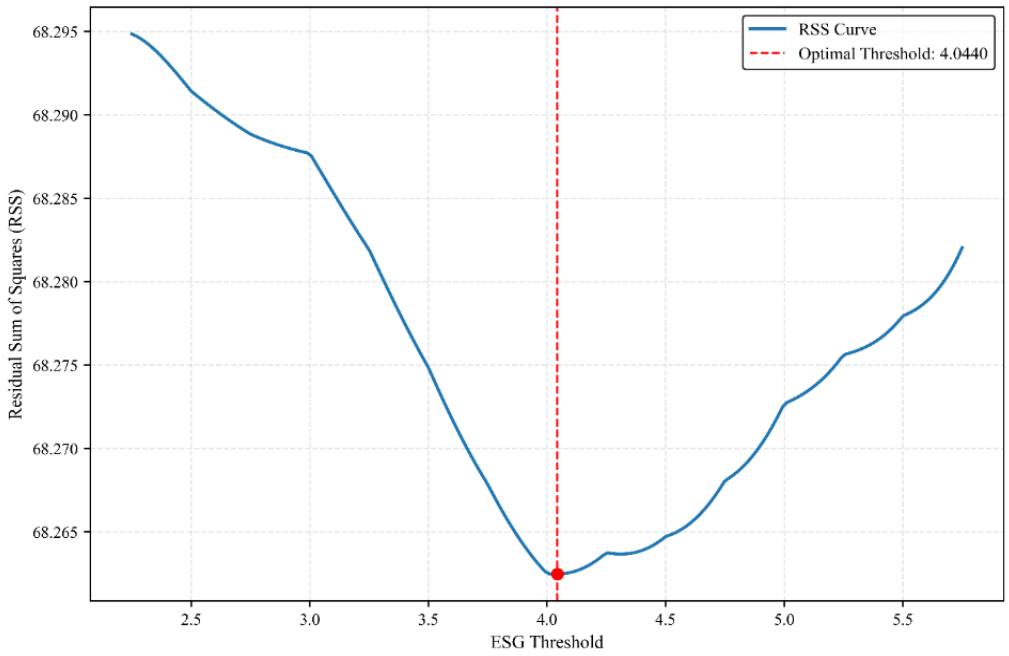

Fig. 1 RSS changes with threshold value (Picture credit: Original)

6. Robustness Test

This paper replaces the calculation method of financing cost and uses the ratio of the total amount of corporate interest expenses plus handling fee expenses and other financial expenses to total liabilities at the end of the period to recalculate the financing cost and use it in the regression model [10]. The results are shown in Tables 6 and table 7. It is found that the annual change in ESG and ESG volatility still has a significant impact on financing costs, and the threshold effect of ESG ratings on financing costs still exists significantly, with the threshold remaining at 4.1143 as shown in table 6 and table 7.

Table 6. Regression results - annual changes in ESG ratings

cof2	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
desg	-.002	0	-4.64	0.000	-.002	-.001	***
size	0	0	0.39	0.695	-.001	.001	
idr	.004	.004	1.14	0.254	-.003	.011	
roa	.004	.005	0.84	0.399	-.006	.015	
lev	.002	.001	1.57	0.118	-.001	.005	
bs	.001	0	5.00	0.000	0	.001	***
Constant	.008	.009	0.98	0.326	-.008	.025	

Table 7. Regression results – ESG volatility

cof2	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
vol	.003	0	8.30	0.000	.002	.003	***
size	0	0	0.27	0.789	0	0	
idr	.002	.002	0.90	0.366	-.002	.006	
roa	-.026	.003	-8.52	0.000	-.032	-.02	***
lev	.016	.001	20.26	0.000	.014	.017	***
bs	0	0	1.80	0.072	0	0	*
Constant	.009	.002	5.07	0.000	.005	.012	***

7. Conclusion

This paper reveals the triple mechanism by which ESG performance affects corporate financing costs within a dynamic analysis framework. Empirical evidence shows that: First, the speed of ESG score improvement (ΔESG) has independent explanatory power compared to the static level. The faster the improvement, the lower the debt financing cost, reflecting a speed premium. Second, the higher the ESG score volatility (σESG), the stronger the market's doubts about the company's commitment and risk management, and the higher the premium on financing costs, confirming the volatility penalty. Third, the rating impact is piecewise linear and has a critical threshold (4.0–4.1 on the Huazheng 9-level scale, B), and marginal financing benefits decrease after crossing the threshold. The above findings break through the static assumption, systematically confirm the independent role of ESG dynamic indicators, and explain the nonlinearity of the input-return relationship with the threshold effect, providing a key parameter basis for the resource allocation efficiency model.

Therefore, companies should proceed in stages: in the short term, prioritize stabilizing ESG performance to reduce volatility penalties. Concentrate resources in the medium term to quickly cross key rating thresholds. Long-term shift to refined, cost-efficiency-oriented ESG management above

the threshold. At the theoretical and policy levels, future research can further optimize the measurement and causal identification of dynamic indicators, combine higher-frequency and cross-market data to test external validity, and examine industry and property rights heterogeneity and the interactive effects with institutional environments such as green bonds and credit ratings, to deepen sustainable finance theory and improve the operability of practical decision-making.

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