



ESG Performance and Cost of Debt in Chinese A-Share Firms with Dual Rating Evidence and Ownership Heterogeneity

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Abstract. Environmental, Social, and Governance (ESG) performance, as a core indicator of corporate sustainability, has increasingly been integrated into debt pricing mechanisms. This study uses 2015–2024 data on A-share listed companies in Shanghai, Shenzhen, and Beijing and employs dual ESG ratings from *Huazheng* and *SynTao Green Finance* to examine the effect of corporate ESG performance on cost of debt and the moderating role of cash holdings. The results indicate that ESG performance is significantly negatively associated with cost of debt, and this effect is concentrated among non-state-owned firms. Moreover, higher cash holdings attenuate the marginal benefit of ESG in lowering financing costs, suggesting that cash reserves and ESG reputational capital may serve as substitutes in reducing expected default losses. The findings offer quantifiable empirical guidance for regulators to design differentiated green disclosure requirements, for non-state-owned firms to develop mechanisms linking ESG performance to interest savings, and for growth firms to consider reputational commitments as partial substitutes for certain financial solidity thresholds.

Keywords: ESG Performance, Cost of Debt, Cash Holdings, State Ownership, Panel Regression.

1 Introduction

In recent years, with the concurrent advancement of the “dual-carbon” strategy, green finance initiatives, and sustainable disclosure standards, Environmental, Social, and Governance (ESG) information has shifted from a peripheral disclosure item to a core parameter influencing capital allocation [1]. Debt financing remains a primary source of funds for corporate operations and expansion, and its cost directly affects firms’ financial burden and investment capacity [2]. Against the backdrop of China’s capital market gradually abandoning rigid payment guarantees and strengthening market-based default resolution mechanisms, establishing whether and how ESG performance influences cost of debt is consequential for corporate financial decision making, for regulatory guidance on green bond issuance, and for investors’ due diligence frameworks. Existing studies have examined the links between ESG and credit risk, bond

spreads, or bank lending conditions, but three gaps remain. First, most sample periods end before 2018 and therefore do not capture the post-implementation equilibrium following institutional shocks such as the central bank's green finance evaluation measures. Second, reliance on a single ESG rating source complicates the removal of rating-agency industry biases. Third, discussions of ownership heterogeneity have largely remained theoretical and lack large-sample tests grounded in China's institutional context.

To address these gaps, this paper employs annual data from 2015 to 2024 for nonfinancial A-share listed firms in Shanghai, Shenzhen, and Beijing. It incorporates dual ESG ratings from *Huazheng* and *SynTao Green Finance* into a model of cost of debt and conducts heterogeneity test by firm ownership while examining the moderating role of cash holdings. The study systematically investigates whether the proposition that ESG reduces cost of debt holds in China, the conditions under which it holds, and the magnitude of the effect, thereby providing microlevel evidence to inform green finance policy refinement and corporate financial strategy. This paper contributes to the literature in three respects. First, at the conceptual level, it integrates the potential substitution between financial slack and reputational capital into the ESG debt pricing framework, testing the boundary at which cash holdings crowd out the cost-reducing effect of ESG and extending Financial Slack Theory to a green finance setting. Second, at the data level, it constructs a long panel covering ten years, uses dual ESG ratings across the full nonfinancial A-share universe, and implements lagged explanatory variables with two-way fixed effects to mitigate endogeneity concerns and enhance external validity. Third, at the empirical level, the findings indicate that the cost-reducing effect of ESG is significant only for non-state-owned firms and is substantially attenuated for firms with high cash holdings. These results offer actionable empirical guidance for regulators to design differentiated green bond disclosure requirements, to advance de-guaranteeing reforms for state-owned enterprises, and to permit growth firms to substitute certain financial solidity thresholds with verifiable green commitments.

2 Theoretical Basis and Research Hypotheses

2.1 The Relationship Between Corporate ESG Performance and Cost of Debt

Reputation Theory conceptualizes firms as continual producers of reputation capital [3]. Sustained investments and verifiable performance in environmental, social, and governance dimensions are internalized by external stakeholders and transformed into an intangible asset, which is reputation capital. In debt markets, reputation capital yields a self-enforcing incentive: a default by a high-reputation firm would incur substantial long-term reputational losses, which induces creditors to expect higher likelihood of contract compliance and to require lower risk premia. Theory of Asymmetric Information complements this view by noting that ESG disclosure supplies soft information absent from traditional financial statements and is subject to multiple corroborating channels, including third-party ratings, media scrutiny, and non-governmental oversight [4]. Enhanced transparency reduces creditors' information search and verification costs and narrows the variance of their forecasts of future cash flows, thereby lowering

default risk premia. These mechanisms operate jointly: reputation capital alters creditors' subjective default probabilities, while greater transparency reduces estimation error of expected default losses, together compressing cost of debt financing rates. Accordingly, this paper proposes the following Hypothesis 1.

H1: Corporate ESG performance is significantly and negatively associated with cost of debt, such that better ESG performance corresponds to lower cost of debt financing.

2.2 The Moderating Role of Cash Holdings

Financial Slack Theory holds that cash is the most liquid form of risk buffer [5]. When firms maintain substantial cash reserves, creditors may lower required risk premia because of an increased expectation of immediate repayment even under pessimistic cash flow forecasts. At the same time, persistent cash abundance can signal weaker investment opportunities or inefficiencies in capital allocation, which may detract from creditors' assessments of overall governance quality [5]. Under these conditions, capital providers' marginal reliance on external credit enhancement signals such as ESG is likely to decline, and the cost-reducing role of ESG may be supplanted by internal liquidity. The Resource-based View further implies that strategic resources with overlapping functions generate substitution effects [6]. Cash and ESG reputation both contribute to reducing expected default losses; when cash holdings are high, creditors have less incentive to reward ESG, thereby constraining the marginal cost-reducing space of ESG. Conversely, firms with limited cash lack internal insurance, prompting creditors to place greater marginal value on ESG reputation and transparency, which amplifies ESG's potential to lower financing costs. Therefore, a Hypothesis 2 is proposed.

H2: Cash holdings negatively moderate the relationship between ESG performance and cost of debt, such that the debt-cost advantage associated with ESG diminishes as cash holding levels increase.

3 Data and Methodology

3.1 Sample Selection and Data Sources

The sample comprises annual data for A-share listed firms in Shanghai, Shenzhen, and Beijing for the period 2015–2024. Financial and market data are obtained from the *Choice* financial data terminal. ESG measures are drawn from the *Huazheng* and *Syn-Tao Green Finance*. To ensure data reliability, the initial sample is subject to the following filters: (1) exclude observations with missing variable values; (2) exclude financial firms; (3) exclude firms that were designated ST or *ST during the sample period; and (4) winsorize continuous variables at the 1st and 99th percentiles to remove outliers. After these procedures, the final dataset contains 13,128 firm-year observations.

3.2 Variable Definition and Measurement

3.2.1 Explained Variables – ESG Rating Scores (*ESG*). Corporate ESG performance is measured using ratings from two providers, *Huazheng* and *SynTao Green Finance*. The *Huazheng* index is among the earliest ESG rating providers in China to obtain regulatory filing and offers full A-share coverage; it combines disclosure information within China's capital market with firm-level characteristics and is widely regarded as an authoritative domestic ESG signal [7]. *Huazheng* produces a weighted score across the environmental, social, and governance dimensions. Following Li & Yuan (2024), *Huazheng* scores are scaled to a 0–100 range, where higher scores indicate better ESG performance [8].

SynTao Green Finance is the first Chinese third-party rater to join the United Nations Principles for Responsible Investment and provides ESG coverage for all A-shares and major Hong Kong listings [9]. Its three-tier framework comprises nearly 200 underlying indicators and applies negative adjustments for adverse events. The E dimension addresses climate, pollution and resources, and green technology; the S dimension covers labor management, community engagement, and customer privacy; the G dimension includes business ethics, shareholder rights, and compliance. *SynTao Green Finance*'s ordinal grades range from D to A+, which are industry-standardized and here converted to a 0–100 scale by assigning D a score of 55 and increasing each grade by five points up to A+ at 100. Higher scores denote superior ESG performance.

Employing both rating sources enables cross-validation and complementary information, thereby mitigating potential scope limitations, industry biases, and greenwashing noise associated with a single provider and enhancing the robustness of the results.

3.2.2 Explanatory Variable – Cost of Debt (*Cost of Debt*). The cost of debt measures the comprehensive interest burden that a firm incurs for the use of debt capital. Following Mei & Zhang (2023), this study operationalizes cost of debt as the ratio of financial expenses to total liabilities at period end [10]. A higher ratio indicates that interest and related expenses per unit of interest-bearing liabilities are greater, implying higher external financing cost and a more pronounced credit risk or bargaining disadvantage. Conversely, a lower ratio suggests that the firm obtains debt at relatively favorable rates and that creditors assign lower probabilities of default and expected loss.

3.2.3 Moderator Variable – Cash Holdings (*Cash Ratio*). Cash holdings capture the adequacy of a firm's immediately available liquidity buffer and are measured as cash and cash equivalents divided by total assets [11]. A higher cash ratio denotes greater internal liquid resources, enabling the firm to meet investment needs, service debt, or smooth cash flow fluctuations without external financing, thereby enhancing financial flexibility. A lower cash ratio signals a thinner liquidity buffer, such that declines in operating cash flow or concentrated debt maturities may force the firm to raise funds at higher cost, increasing the debt risk premium.

3.2.4 Control Variables. To mitigate omitted variable bias, the regressions include a set of firm-level controls reflecting fundamental differences. These controls are firm size (logarithm of total assets, denoted as *Size*), *Sales Growth* (year-on-year growth rate of operating revenue), *Fixed Asset Ratio* (the ratio of fixed assets to total assets), firm age (*AGE*), and return on assets (*ROA*).

3.3 Empirical Models

Based on Hypothesis 1, the study estimates the following panel regression model.

$$\text{Cost of Debt}_{i,t} = \mu_0 + \mu_1 \text{ESG}_{i,t-1} + \mu_2 \text{Controls}'_{i,t-1} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (1)$$

Here, *Controls'* includes the moderator variable specified in Section 3.2.3 and the control variables listed in Section 3.2.4. *Year* and *Industry* denote year and industry fixed effects that absorb systematic shocks arising from macroeconomic cycles, interest rate conditions, and industry-level fluctuations. $\varepsilon_{i,t}$ is the idiosyncratic error term. The two-way fixed effects panel specification permits a consistent estimate of the marginal effect of lagged ESG performance on contemporaneous cost of debt while accounting for cross-sectional heterogeneity and common time trends. A significantly negative estimate of μ_1 supports Hypothesis 1.

To test Hypothesis 2 on the moderating role of cash holdings, the following interaction model is estimated:

$$\text{Cost of Debt}_{i,t} = \beta_0 + \beta_1 \text{ESG}_{i,t-1} + \beta_2 (\text{ESG}_{i,t-1} * \text{Cash Ratio}_{i,t-1}) + \beta_3 \text{Cash Ratio}_{i,t-1} + \beta_4 \text{Controls}'_{i,t-1} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \quad (2)$$

Here, *Controls'* only includes the control variables listed in Section 3.2.4. A positive and significant β_2 indicates that cash holdings attenuate the negative relationship between ESG performance and cost of debt, consistent with Hypothesis 2.

4 Research Results and Analysis

4.1 Descriptive Analysis

Table 1 reports descriptive statistics for all variables. Over the sample period, the mean of *Huazheng* ESG score is 74.36 and that of *SynTao Green Finance* is 77.16; both lie in the midrange of their respective scales, with standard deviations of 4.31 and 5.00, suggesting moderate dispersion in ESG performance among A-share firms. The mean of *Cost of Debt* is 0.05 percent, while the median is 0.61 percent. The minimum is -14.58 percent and the maximum is 4.65 percent, indicating a right-skewed distribution characterized by a low mean and wide range; most firms bear modest interest expenses, while a subset exhibits extreme values or negative net interest due to interest income exceeding interest expense. The mean of *Cash Ratio* equals 15.89 percent with a median of 12.84 percent, implying that sample firms typically maintain a liquidity buffer

of roughly 15 percent of assets. *Sales Growth* has an average of 8.5 percent but displays substantial dispersion (standard deviation of 28.4 percent; a maximum of 136.6 percent; the minimum of -55.1 percent), reflecting heterogeneous growth prospects. *Firm Size*, *Fixed Asset Ratio*, *firm Age*, and *ROA* present distributions consistent with typical nonfinancial listed firms.

Table 1. Descriptive statistical results.

Variable	Count	Mean	Standard deviation	Minimum	Median	Maximum
<i>ESG_Huazheng</i>	13128	74.3649	4.3067	62.8000	74.1300	85.0800
<i>ESG_SynTao Green</i>	13128	77.1595	5.0038	70.0000	75.0000	90.0000
<i>Cost of Debt</i>	13128	0.0005	0.0301	-0.1458	0.0061	0.0465
<i>Size</i>	13128	22.8428	1.4944	20.0110	22.6841	26.8650
<i>Sales Growth</i>	13128	0.0850	0.2840	-0.5514	0.0597	1.3656
<i>Fixed Asset Ratio</i>	13128	0.1974	0.1521	0.0021	0.1623	0.6537
<i>Cash Ratio</i>	13128	0.1589	0.1146	0.0141	0.1284	0.5866
<i>Age</i>	13128	21.9765	6.0434	8.0000	22.0000	39.0000
<i>ROA</i>	13128	0.0380	0.0670	-0.1911	0.0361	0.2370

4.2 Multicollinearity Test

The study first computes pairwise correlation coefficients and finds that the correlations between *ESG_Huazheng* and *Cost of Debt* and between *ESG_SynTao Green* and *Cost of Debt* are -0.1871 and -0.0549, respectively, suggesting an initial negative association between the independent and dependent variables. To assess potential multicollinearity among regressors, the variance inflation factor (VIF) is employed. VIF quantifies the proportion of variance in an independent variable that is predictable from other regressors; larger values indicate more severe multicollinearity [12]. A common rule of thumb is that VIF values below 10 indicate the absence of multicollinearity that would materially distort estimates of standard errors and statistical inference.

Table 2 reports the VIF results for the model covariates. The maximum VIF in the sample is 1.3925, well below the conventional threshold, indicating limited linear dependence among explanatory variables. Thus, multicollinearity is not a concern for the estimated models, supporting the reliability of subsequent coefficient estimates and inference.

Table 2. Variables' VIF calculation.

	Feature	VIF
1	<i>ESG_Huazheng</i>	1.3925
2	<i>ESG_SynTao Green</i>	1.2548
3	<i>Size</i>	1.2486
4	<i>Sales Growth</i>	1.1474

	Feature	VIF
5	<i>Fixed Asset Ratio</i>	1.1355
6	<i>Cash Ratio</i>	1.2747
7	<i>Age</i>	1.0410
8	<i>ROA</i>	1.2170

4.3 Panel Regression Analysis

4.3.1 Results of Hypothesis 1. The baseline models on the full sample are examined to test Hypothesis 1. Table 3 summarizes the principal multiple regression results. Across both *Huazheng* and *SynTao Green* ESG measures, higher ESG performance is associated with significantly lower cost of debt. For example, the *Huazheng* ESG coefficient controlling for industry fixed effects is -0.0004 . Interpreting this coefficient, a one standard deviation increases in *ESG_Huazheng* (4.3067) is associated with an expected reduction in cost of debt of approximately 0.1723 percentage points for a firm with average debt size. Although the magnitude is modest, even small decreases in borrowing costs can shift firms across implicit investment thresholds in sensitive credit markets, enabling greater long-term debt capacity and more favorable contractual terms. These results support Hypothesis 1. In contexts where hard collateral is limited, creditors appear to treat superior ESG performance as a positive signal of future contract compliance and therefore demand lower risk premia.

The research further conducts subsample analyses by ownership type to compare the effect of *ESG_Huazheng* on *Cost of Debt* for state-owned and non-state-owned firms. The ESG coefficient is not statistically significant in the state-owned sample, whereas it is negative and statistically significant at the 5 percent level in the non-state-owned sample. This pattern implies that the overall negative relationship between ESG and cost of debt is primarily driven by non-state-owned firms. A plausible explanation is that state-owned firms benefit from implicit government support, which leads creditors to price risk closer to sovereign or government-anchored benchmarks rather than firm-level signals; consequently, the marginal credit enhancement provided by ESG is crowded out. Non-state-owned firms lack such implicit backstops, so creditors rely more heavily on observable soft signals such as ESG to differentiate credit risk, amplifying the cost-reducing effect of ESG for these firms.

Table 3. Baseline regression results.

	<i>ESG_Huazheng</i>		<i>ESG_SynTao Green</i>	<i>State-owned enterprises</i>	<i>Non-state-owned enterprises</i>
	(1)	(2)			
<i>ESG</i>	-0.0004*** (-6.3086)	-0.0002** (-2.3956)	-0.0001* (-1.9471)	-0.0001 (-0.7315)	-0.0002** (-2.0016)
<i>Size</i>	0.0023*** (8.8359)	0.0030* (1.6609)	0.0020*** (10.373)	0.0038 (1.5694)	0.0028 (1.2769)
<i>Sales Growth</i>	0.0071*** (8.0575)	0.0008 (0.9654)	0.0074*** (9.5635)	0.0008 (0.8521)	0.0009 (0.8015)

	<i>ESG_Huazheng</i>		<i>ESG_SynTao</i> <i>Green</i>	<i>State-owned</i> <i>enterprises</i>	<i>Non-state-owned</i> <i>enterprises</i>
	(1)	(2)			
<i>Fixed Asset</i> <i>Ratio</i>	0.0144*** (6.5732)	0.0206*** (4.2208)	0.0149*** (9.0458)	0.0303*** (3.5392)	0.0178*** (3.0303)
<i>Cash Ratio</i>	-0.1202*** (-25.814)	-0.0617*** (-6.7959)	-0.1225*** (-60.944)	-0.0494*** (-3.6004)	-0.0647*** (-5.9108)
<i>Age</i>	0.0001 (0.7115)	0.0017 (0.9460)	0.0001* (1.8559)	0.0019 (0.5579)	0.0020 (1.3316)
<i>ROA</i>	-0.0936*** (-18.132)	-0.0265*** (-3.9579)	-0.0984*** (-29.026)	-0.0336** (-2.0968)	-0.0267*** (-3.5543)
<i>Industry FE</i>	Yes		Yes		
<i>Firm FE</i>		Yes		Yes	Yes
<i>Year FE</i>	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.4103	0.0653	0.4072	0.0914	0.0617
<i>N</i>	13128	13128	13128	3154	9947

Note: The data in the table are regression coefficient and t-value of each variable, and ***, **, and * are significant at the significance level of 1%, 5% and 10% respectively.

4.3.2 Results of Hypothesis 2. The paper hence examines the moderating role of cash holdings in the relationship between ESG performance and cost of debt financing by including an interaction term between *ESG_Huazheng* and the *Cash Ratio*. In Table 4, after controlling for covariates, the interaction coefficient is positive and statistically significant at the 5 percent level, indicating that cash holdings attenuate the negative effect of ESG on cost of debt. In other words, when a firm’s cash reserves are substantial, the cost-reducing effect of superior ESG performance is weakened. A plausible interpretation is that high cash provides a hard liquidity buffer that raises expectations of immediate repayment, thereby reducing the marginal utility of ESG as a soft credit enhancement. Cash and ESG thus perform overlapping functions in lowering expected default losses; when internal liquidity is abundant, the bargaining weight accorded to external reputation signals is diluted and the interest-rate advantage associated with ESG converges. These findings support Hypothesis 2.

Table 4. Regression results for Hypothesis 2.

	<i>Full sample</i>	
	(a)	(b)
<i>ESG_Huazheng</i>	-0.0009*** (-6.8802)	-0.0008*** (-5.8522)
<i>ESG_Huazheng * Cash Ratio</i>	0.0026*** (2.6020)	0.0022** (2.1802)
<i>Cash Ratio</i>	-0.3364*** (-4.4854)	-0.2865*** (-3.7351)
<i>Size</i>		0.0023***

	<i>Full sample</i>	
	(a)	(b)
		(8.8703)
<i>Sales Growth</i>		0.0071***
		(8.0814)
<i>Fixed Asset Ratio</i>		0.0145***
		(6.6144)
<i>Age</i>		0.0001
		(0.7858)
<i>ROA</i>		-0.0932***
		(0.0052)
<i>Industry FE</i>	Yes	Yes
<i>Year FE</i>	Yes	Yes
<i>R-squared</i>	0.3662	0.4115
<i>N</i>	13128	13128

Note: The data in the table are regression coefficient and t-value of each variable, and ***, **, and * are significant at the significance level of 1%, 5% and 10% respectively.

5 Conclusion

Using a panel of 13,128 firm-year observations for A-share listed firms in Shanghai, Shenzhen, and Beijing from 2015 to 2024 and cross-validating ESG performance with *Huazheng* and *SynTao Green* ratings, this paper systematically assesses the effect of ESG performance on cost of debt and the moderating role of cash holdings. The principal findings are as follows. First, ESG performance is significantly and negatively associated with cost of debt, and this effect is primarily driven by non-state-owned firms. For state-owned firms, implicit government support appears to crowd out firm-level reputation signals, attenuating the cost-reducing function of ESG. Second, cash holdings negatively moderate the cost-reducing effect of ESG. Abundant internal liquidity lowers creditors’ marginal reliance on ESG reputation because of increased expectations of immediate repayment, whereas cash-constrained firms lack internal insurance and thus induce creditors to place greater marginal value on ESG information, fully realizing ESG’s potential to reduce financing costs. These results hold under two-way fixed effects and a range of controls, corroborating the complementary mechanisms of Reputation Theory and Information Asymmetry in debt pricing and highlighting the dilution of reputational marginal utility by financial slack.

Policy implications follow. For non-state-owned firms, they should incorporate ESG investments into financial cost management so that potential interest savings can be weighed against ESG expenditures, creating a sustainable linkage between ESG and cost reduction. For state-owned firms, regulators might require disclosure of ESG premia in bond issuances, compelling issuers to report differences in ESG scores relative to comparable non-state firms and thereby using market mechanisms to strengthen

ESG transparency and mitigate the crowding-out effect of implicit guarantees. Considering the role of cash holdings, regulators could require cash-rich listed firms to disclose both cash ratios and ESG scores and to explain how these resources jointly mitigate default risk, preventing cash abundance from substituting for reputation investment and generating greenwashing arbitrage. For cash-constrained growth firms, policymakers might selectively relax green bond issuance thresholds by allowing verifiable one-year ESG improvement commitments to substitute for certain traditional financial solidity indicators, thereby enabling such firms to allocate scarce cash to green transformation and technological upgrading rather than to servicing high-cost debt.

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