



Greenwashing Premium or Penalty? ESG Disclosure and Corporate R&D Investment Under Financing Constraints

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Abstract. This study investigates the impact and contextual boundaries of environmental, social, and governance (ESG) disclosure on corporate research and development (R&D) investment using a sample of Chinese A-share firms listed in Shanghai, Shenzhen, and Beijing from 2014 to 2024. The paper introduces a firm-level greenwashing index and measures the cost of equity to examine how disclosure affects innovation investment. The results indicate that ESG disclosure significantly increases R&D intensity, with stronger effects in non-state-owned enterprises and in firms with high levels of institutional ownership. Greenwashing behavior positively moderates this relationship, suggesting that some firms engage in a strategic “research-driven remediation” response, using R&D investments to offset their greenwashing behavior. Conversely, the cost of equity negatively moderates the effect, indicating that high financing costs constrain the translation of disclosure signals into resource commitments. By integrating the divergence between stated commitments and enacted behavior into the ESG-innovation framework, the study uncovers the nonlinear consequences of greenwashing and offers evidence to inform differentiated information disclosure regulation and the allocation of green finance resources.

Keywords: ESG Disclosure, Greenwashing, R&D Investment, Cost of Equity, Signal Credibility.

1 Introduction

With the increasing prominence of sustainable development, environmental, social, and governance (ESG) ratings have become an important input for capital markets in valuing firms. The credibility of the ESG rating industry, however, is under pressure because some firms cultivate a superficially strong ESG profile through selective disclosure, rhetorical embellishment, and other practices commonly described as greenwashing [1]. Such behavior not only undermines the informational efficiency of ESG signals but may also divert resources away from substantive green innovation and thereby adversely affect research and development (R&D) investment.

Prior literature has examined the economic consequences of ESG information quality. Berg et al. (2022) reported that the correlation between ESG ratings for the same

firm across different rating providers is only 0.54, documenting substantial heterogeneity in assessments [2]. Avramov et al. (2022) further showed that deterioration of the ESG information environment elevates firms' risk premium and financing costs [3]. These contributions, however, emphasize inter-provider rating divergence and do not fully address within-firm discrepancies between disclosed ESG information and realized performance. In other words, the literature has not sufficiently examined how greenwashing alters the effectiveness of signal transmission and thereby influences substantive innovation investment. Moreover, although some studies indicate that ESG performance can stimulate corporate innovation, there is limited empirical evidence on the direct effect of ESG disclosure and on how financing constraints, proxied by the cost of equity, delimit the relationship between ESG disclosure and innovation. Motivated by these gaps, this study employs a dual perspective that combines signal distortion and financing constraints. Using data on non-financial A-share firms listed in Shanghai, Shenzhen, and Beijing from 2014 to 2024, the paper systematically investigates the association between ESG disclosure and R&D investment and tests the moderating roles of greenwashing behavior and the cost of equity. The analysis seeks to provide empirical guidance for improving corporate ESG disclosure regimes and for policies that support innovation.

This article contributes in three principal respects. First, in terms of topic, it moves beyond the prevailing aggregate focus on ESG information quality by incorporating firm-level greenwashing into the analytical framework linking ESG disclosure and innovation. Doing so reveals how distorted ESG signals shape firms' innovation choices and offers a more complete account of the real economic effects of ESG disclosure. Second, conceptually, the study introduces the cost of equity as a proxy for financing constraints and emphasizes signal conversion efficiency rather than only signal transmission. This approach identifies the financing threshold under which ESG disclosure effectively promotes innovation and thereby refines understanding of the boundary conditions of ESG effects. Third, empirically, the research finds that greenwashing positively moderates the relationship between ESG disclosure and innovation. This counterintuitive result challenges the assumption that greenwashing uniformly suppresses innovation and highlights remedial innovation strategies firms may adopt under reputational pressure and regulatory scrutiny. The finding provides novel evidence on the particularities of corporate ESG practices in the Chinese institutional context.

2 Theoretical Basis and Research Hypotheses

2.1 The Relationship between ESG Disclosure and R&D Investment

Signal transmission theory holds that in markets characterized by information asymmetry; informed parties convey private information through signals to reduce adverse selection faced by uninformed parties [4]. Firm R&D activities are characterized by high uncertainty and long cycles, which impedes external investors' ability to assess true innovation capacity and future cash flows and thereby generates financing constraints for innovative firms [5]. ESG disclosure functions as a signal of corporate long termism. By interpreting this signal, investors can identify firms that are willing to incur

short-term costs for long-term returns and that demonstrate a sustained commitment to innovation, increasing their propensity to provide stable, long-term financing for R&D. ESG disclosure also lowers information acquisition costs, enabling investors to obtain firms' nonfinancial information more cheaply, which facilitates more accurate assessments of the probability of R&D success and expected returns, reduces uncertainty, and raises investment willingness. Moreover, ESG signals entail a self-selection mechanism, i.e., imitation of high-quality ESG disclosure imposes substantial costs on low-quality firms. Consequently, ESG performance serves as an effective screening device, allowing investors to distinguish firms with genuine innovation potential and managerial capability, mitigate adverse selection, and direct resources toward high-quality innovators. On the basis of the foregoing theoretical considerations, the paper proposes the following Hypothesis 1.

H1: Corporate ESG disclosure level is positively associated with R&D investment.

2.2 The Moderating Effect of Greenwashing Behavior

A key assumption of signal transmission theory is the credibility of signals. Signals effectively separate types and convey information only when signaling costs are sufficiently high and low-quality senders cannot imitate them easily [4]. In the context of ESG disclosure, greenwashing undermines this assumption. Under a credible signaling equilibrium, the costs associated with substantive ESG engagement, such as meaningful environmental investments and social responsibility activities, deter imitation by low-quality firms [6]. Greenwashing circumvents these costs through low-effort embellishment, eroding the self-selection mechanism of ESG signals and exacerbating adverse selection for investors. When greenwashing becomes widespread, aggregate trust in ESG signals declines, and even genuinely committed firms may find their disclosure insufficiently recognized by the market, producing a deleterious effect on signal efficacy. As a result, in environments with a high prevalence of greenwashing, the positive effect of ESG disclosure on R&D investment is likely to be attenuated because investors' willingness to allocate resources to ostensibly ESG-advantaged firms is diminished. Hence, a Hypothesis 2 is advanced.

H2: Greenwashing behavior negatively moderates the positive relationship between ESG disclosure and R&D investment.

2.3 The Moderating Effect of Cost of Equity

The literature on financing constraints emphasizes that elevated external financing costs inhibit firms' investment activity, particularly for long-cycle, high-uncertainty projects such as R&D [5]. The cost of equity, as the price of equity financing, captures investors' required risk premia and serves as an aggregate indicator of a firm's financing constraints [7]. When the cost of equity is high, firms face a restrictive external financing environment, internal-external financing substitution is constrained, and overall liquid reserves are limited. Under these conditions, the conversion of ESG disclosure into tangible resources encounters a bottleneck. On the one hand, ESG disclo-

sure can reduce information asymmetry and signal long-term commitment, thereby facilitating access to external resources. On the other hand, when a firm experiences high equity costs, this reflects deep-seated risk perceptions or information problems that marginal improvements in ESG disclosure cannot readily reverse. Thus, although ESG signals may persuade investors of a firm's strategic orientation, they are unlikely to fully compensate for investor concerns about short-term liquidity and repayment capacity. Consequently, firms with high costs of equity may be unable to translate information advantages from ESG disclosure into increased R&D expenditure, producing a situation of effective signals but ineffective resource acquisition. Empirical studies provide indirect support for this argument. For example, Brown & Petersen (2011) documented that financing constraints would substantially weaken the persistence of corporate R&D investment [8]. Ju et al. (2013) found that working capital smoothing was more crucial for financing R&D when financing constraints were severe, which implies that high external financing costs force firms to safeguard operations at the expense of innovation [9]. These findings suggest that financing costs impose a general constraint on innovation and limit the efficacy of ESG disclosure as a mechanism for mobilizing resources. The following Hypothesis 3 is proposed.

H3: The cost of equity negatively moderates the relationship between ESG disclosure and R&D investment, such that the positive effect of ESG disclosure on R&D investment weakens as the cost of equity increases.

3 Data and Methodology

3.1 Sample Selection and Data Sources

The sample comprises Chinese A-share listed firms for the period 2014 to 2024. Primary data sources include the *Bloomberg*, *Sino-Securities Index Information Service (Shanghai) Co., Ltd.*, *CSMAR*, and *Choice* databases. The initial sample is subject to the following screening procedures to ensure result reliability: (1) exclusion of firms in the financial sector; (2) exclusion of firms under special treatment, such as ST and *ST; (3) removal of observations with missing values for key variables; and (4) winsorization at the 1st and 99th percentiles to mitigate the influence of outliers. After these procedures, the final sample consists of 4,803 firm-year observations.

3.2 Variable Definition and Measurement

3.2.1 Explained Variable – R&D Investment (*RD*). R&D investment is the primary outcome of interest and is measured as the ratio of R&D expenditure to operating income. A higher value indicates greater firm engagement in innovation activities. R&D expenditure represents the substantive and material commitment to support innovation processes.

3.2.2 Explanatory Variable – ESG Disclosure Score (ESG). The core explanatory variable is the ESG disclosure score, which captures the firm's overall level of environmental, social, and governance disclosure. The research employs *Bloomberg's* ESG disclosure score as the primary measure. *Bloomberg* derives this score from publicly disclosed firm information and evaluates disclosure quality across the environment, social, and governance dimensions on a 100-point scale. A higher score denotes greater disclosure quality and higher transparency of nonfinancial information. The *Bloomberg* ESG disclosure score is selected because of its comprehensive coverage of A-share and other listed firms, its frequent use in international ESG research facilitating comparability, and its suitability for constructing firm-level indicators of greenwashing [10].

3.2.3 Moderator Variables. ① Greenwashing behavior (*GW*): Greenwashing behavior captures the extent of divergence between a firm's ESG disclosure and its realized environmental performance, that is, the degree to which a firm inflates its ESG image through selective disclosure, exaggeration, or similar practices. Following Hu (2023), the paper introduces the greenwashing index as shown in equation (1) [1].

$$GW_i = \left(\frac{ER_i - \overline{ER}_{dis}}{\sigma_{dis}} \right) - \left(\frac{ER_i - \overline{ER}_{per}}{\sigma_{per}} \right) \quad (1)$$

Here, ER_{dis} denotes firm i 's *Bloomberg* ESG disclosure score in year t ; and ER_{per} denotes firm i 's *Huazheng* ESG rating in year t . Both the minuend and subtrahend represent the standardized position of the firm's corresponding score relative to its industry peers. A larger GW value indicates that the *Bloomberg* disclosure score exceeds the *Huazheng* performance score by a greater margin, implying a larger gap between disclosure and actual performance and thus more severe greenwashing. The rationale for using two institutional data sources is that a single rating provider cannot effectively separate disclosure effort from underlying performance. *Bloomberg's* ESG disclosure score emphasizes the quality of publicly disclosed information, whereas *Huazheng's* ESG rating emphasizes substantive ESG performance. The difference between these measures therefore serves as a proxy for firms' enhancement of ESG image through verbal modification rather than substantive improvement. This approach follows prior practices that identify greenwashing by comparing cross-provider assessment divergences.

② Cost of equity (*COE*): The cost of equity is estimated using a Price/Earnings-to-Growth (PEG)-based approach as the following equation (2).

$$COE = \sqrt{\frac{eps_{t+2} - eps_{t+1}}{P_t}} \quad (2)$$

Here, eps_{t+2} and eps_{t+1} are analysts' consensus forecasts of earnings per share for the next two periods from, and P_t is the current share price. This method is widely adopted because of its operational simplicity and limited reliance on dividend assumptions.

3.2.4 Control Variables. Consistent with the literature on determinants of corporate innovation, the regression models include the following control variables: institutional ownership ratio (*INST*), firm size (*SIZE*, measured as the natural logarithm of firm's total assets), leverage ratio (*LEV*), return on assets (*ROA*), firm's year-over-year growth rate of operating income (*GROWTH*), operating cash flow (*CF*), book to market ratio (*BM*), proportion of independent directors (*IND*), largest shareholder ownership concentration (*TSH1*), and firm age (*AGE*).

3.3 Empirical Models

To test Hypothesis 1, the paper estimates the following regression model, as shown in equation (3).

$$RD_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t-1} + \alpha_2 \mathbf{Controls}'_{i,t-1} + \gamma_t + \lambda_i + \varepsilon_{i,t} \quad (3)$$

Here, **Controls** includes the moderating variables defined in Section 3.2.3 and the control variables defined in Section 3.2.4. γ_t denotes time fixed effects and λ_i denotes entity fixed effects, which provide stronger control for endogeneity than industry fixed effects and are therefore included in the baseline specification. $\varepsilon_{i,t}$ is the stochastic error term. A significantly positive α_1 would support H1.

To examine the moderating role of greenwashing (H2), the research introduces the interaction between greenwashing and ESG disclosure and estimate in the equation (4).

$$RD_{i,t} = \beta_0 + \beta_1 ESG_{i,t-1} + \beta_2 GW_{i,t-1} + \beta_3 (ESG_{i,t-1} \times GW_{i,t-1}) + \beta_4 \mathbf{Controls}'_{i,t-1} + \gamma_t + \lambda_i + \varepsilon_{i,t} \quad (4)$$

Here, **Controls** contains the control variables in 3.2.4, and also the *COE*. A significantly negative β_3 indicates that greenwashing attenuates the positive effect of ESG disclosure on R&D investment, supporting H2.

To test the moderating effect of the cost of equity capital (H3), the paper includes the interaction between ESG disclosure and the cost of equity. The model is shown as equation (5).

$$RD_{i,t} = \theta_0 + \theta_1 ESG_{i,t-1} + \theta_2 COE_{i,t-1} + \theta_3 (ESG_{i,t-1} \times COE_{i,t-1}) + \theta_4 \mathbf{Controls}'_{i,t-1} + \gamma_t + \lambda_i + \varepsilon_{i,t} \quad (5)$$

In this model, **Controls** contains all the control variables in 3.2.4, and *GW*. A significantly negative θ_3 implies that the cost of equity capital negatively moderates the relationship between ESG disclosure and R&D investment, supporting H3.

4 Research Results and Analysis

4.1 Descriptive Analysis

Table 1 reports descriptive statistics for the principal variables. To ensure consistency in measurement units, proportional variables in Table 1 are uniformly reported in percentage form. The dependent variable, R&D investment (*RD*), has a mean of 4.6992, a standard deviation of 5.6285, and a median of 3.3637, indicating substantial cross-sectional heterogeneity in R&D intensity and a right-skewed distribution. The core explanatory variable, *ESG*, has a mean of 36.7496, and a median of 34.0006, suggesting a moderate overall level of ESG disclosure. The moderating variable greenwashing score (*GW*) has a mean of 0.0364, a standard deviation of 1.1553, and a median of -0.0024, implying a low average degree of greenwashing but large dispersion across firms. The moderating variable cost of equity (*COE*) has a mean of 0.1023 and a standard deviation of 0.0356, both falling within a reasonable range. The distributions of the remaining control variables are consistent with the characteristics of Chinese A-share listed firms.

Table 1. Descriptive statistical results.

Variable	Count	Mean	Standard deviation	Minimum	Median	Maximum
<i>RD</i>	4803	4.6992	5.6285	0.0276	3.3637	32.8987
<i>ESG</i>	4803	36.7496	9.2030	24.0821	34.0006	63.3739
<i>GW</i>	4803	0.0364	1.1553	-2.5316	-0.0024	3.2388
<i>COE</i>	4803	10.5411	3.5762	3.0555	10.1560	22.7324
<i>INST</i>	4803	56.2091	21.8896	5.2752	59.6513	93.5386
<i>A</i>	4803	23.7408	1.2214	21.3042	23.6071	27.2986
<i>LEV</i>	4803	46.7577	18.2051	8.7686	48.3099	83.6483
<i>ROA</i>	4803	7.9293	6.5889	-8.3017	6.5960	31.0599
<i>GROWTH</i>	4803	15.3558	26.4914	-39.0831	11.4830	136.5622
<i>CF</i>	4803	7.2702	6.4157	-9.1937	6.6058	26.4131
<i>BM</i>	4803	47.7739	32.9681	5.4310	39.2655	152.9250
<i>IND</i>	4803	37.6192	5.7031	30.0000	36.3636	57.1429
<i>TSHI</i>	4803	36.8441	15.6824	8.6000	35.4900	76.3100
<i>AGE</i>	4803	21.1574	5.5520	8	21	36

4.2 Correlation Analysis

Pairwise correlations indicate a positive association between ESG disclosure and R&D investment, providing preliminary support for Hypothesis 1. All pairwise correlation coefficients are below 0.7, and the mean variance inflation factor is 1.5799, well below conventional concern thresholds, which suggests that multicollinearity is not a serious issue and that all variables may be retained in the regression analyses.

4.3 Panel Regression Analysis

4.3.1 Results of Hypothesis 1. Table 2 presents the estimated effects of ESG disclosure on corporate R&D investment. The baseline regression indicates that the coefficient on ESG is 0.0190 and is significant at the 1% level. This implies that a one-point increase

in the ESG disclosure score is associated with an average increase of 0.0190 units in R&D intensity, consistent with Hypothesis 1. A plausible interpretation is that higher quality ESG disclosure signals managerial commitment to long term sustainable development, which motivates greater allocation of resources to innovation. High quality disclosure may also reduce information asymmetry and alleviate financing frictions, thereby facilitating R&D financing.

To examine heterogeneity by ownership, the sample is partitioned into state-owned enterprises (SOEs) (1,238 observations) and non-SOEs (3,565 observations). The ESG coefficient for SOEs is 0.0140 and is not statistically significant. For non-SOEs, the ESG coefficient is 0.0194 and is significant at the 5% level. These results indicate that the positive effect of ESG disclosure on R&D investment is primarily driven by non-SOEs. One explanation is that SOEs often face additional policy and social obligations that may render ESG disclosure more compliance driven than strategically transformational, weakening its association with innovation [11]. Non-SOEs face greater market competition and tighter financing constraints, so that ESG disclosure functions as a more salient signal for securing external resources to support R&D.

The paper further follows Li et al. (2021) to classify firms by pollution intensity using the China Securities Regulatory Commission industry classification and the Ministry of Environmental Protection's environmental verification catalogue [12]. The sample is split into heavily polluting firms (1,837 observations) and non-heavily polluting firms (2,966 observations). The ESG coefficient is 0.0194 and significant at the 1% level for heavily polluting firms, and 0.0191 and significant at the 5% level for non-heavily polluting firms. The magnitudes are similar and both effects are significant, suggesting that the positive relationship between ESG disclosure and R&D investment holds across firms facing different environmental regulatory pressures. For heavily polluting firms, ESG disclosure may facilitate legitimacy and mobilize resources for green technological transformation, converting regulatory pressure into innovation incentives. For non-heavily polluting firms, disclosure may still promote innovation by easing financing constraints and enhancing reputation while their lower compliance burden and greater technological flexibility reduce innovation costs.

Finally, the research assesses heterogeneity by institutional ownership. Using the industry-year median to partition the sample, the work obtains a high institutional ownership group (2,362 observations) and a low institutional ownership group (2,441 observations). The ESG coefficient in the high institutional ownership group is 0.0232 and significant at the 1% level; in the low institutional ownership group, it is 0.0150 and not significant. These findings indicate that the positive effect of ESG disclosure on R&D investment is concentrated among firms with substantial institutional holdings. Institutional investors possess stronger information processing capacity and governance incentives, enabling them to distinguish substantive disclosure from greenwashing and to amplify the positive consequences of credible ESG signals. Their long-term orientation also aligns with ESG strategies and can provide stable financial and governance support for R&D. By contrast, firms with low institutional ownership may face greater short-term pressure and weaker transmission of ESG signals, attenuating the ESG to R&D relationship. Consistent with this interpretation, the coefficient on the

greenwashing measure in the low institutional ownership group is -0.1051 and not significant, suggesting that institutional ownership mitigates the adverse effects of greenwashing on innovation.

Table 2. Regression results for Hypothesis 1.

	Full sam- ple	SOEs	Non-SOEs	Heavy pol- luters	Non-heavy polluters	High INST	Low INST
ESG	0.0190***	0.0140	0.0194**	0.0194***	0.0191**	0.0232***	0.0150
GW	-0.0895*	-0.0050	-0.1170*	-0.0710**	-0.1037	-0.0968**	-0.1051
INST	-0.0102**	0.0077***	-0.0168***	-0.0144***	-0.0095	-0.0171**	-0.0216**
COE	0.0110	-0.0066	0.0172	-0.0035	0.0254**	-0.0111	0.0343***
A	0.0728	-0.2779***	0.1473	0.0157	0.0485	-0.0628	0.2153
LEV	-0.0351***	0.0069	-0.0452***	-0.0207***	-0.0470***	-0.0295***	-0.0426***
ROA	-0.0089	0.0333***	-0.0127	-0.0219	0.0022	-0.0275*	-0.0051
GROWTH	-0.0080***	-0.0052***	-0.0084***	-0.0048***	-0.0090***	-0.0039***	-0.0092***
CF	-0.0171***	-0.0149**	-0.0199***	-0.0102	-0.0201***	-0.0037	-0.0269***
BM	-0.0028	0.0038**	-0.0049	-0.0057**	-0.0012	0.0008	-0.0084**
IND	0.0271**	0.0173	0.0339**	0.0016	0.0426**	0.0385**	0.0237**
TSH1	0.0002	-0.0073	0.0041	0.0001	-0.0029	-0.0024	0.0015
AGE	-0.0294	0.0134	-0.0556	-0.0194	-0.0195	-0.1280**	0.0526
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F	9.0986	2.0943	8.1545	3.2193	6.5894	3.1943	6.5714
R-squared	0.0303	0.0275	0.0364	0.0281	0.0359	0.0229	0.0458
N	4803	1238	3565	1837	2966	2362	2441

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

4.3.2 Results of Hypothesis 2 & 3. Table 3 presents tests of the moderating roles of greenwashing and the cost of equity. Column (1) reports the moderation test for greenwashing. The interaction coefficient on $ESG \times GW$ is 0.0079 and is significant at the 1% level, indicating that greenwashing positively moderates the association between ESG disclosure and R&D investment. In other words, a higher degree of greenwashing amplifies the positive effect of ESG disclosure on R&D intensity. Several mechanisms may account for this apparently counterintuitive finding. First, a higher greenwashing score signals amplified promotional activity; although this reflects a divergence between disclosure and substantive practice, it may nevertheless strengthen perceived strategic commitment in the capital market and thereby attract additional resources for R&D. Second, greenwashing itself entails resource expenditures, for example on report preparation and media campaigns; to sustain a green image and close the gap between words and deeds, firms may increase R&D outlays. Third, mounting regulatory scrutiny of misleading ESG claims may induce firms to expand substantive R&D investment to reduce the risk of penalties or reputational sanctions and to move from symbolic to substantive environmental efforts [13].

Column (2) reports the moderation test for the cost of equity. The coefficient on the interaction term $ESG \times COE$ is -0.0038 and is significant at the 1% level, indicating that the cost of equity negatively moderates the relationship between ESG disclosure

and R&D investment. That is, as the cost of equity rises, the positive effect of ESG disclosure on R&D investment weakens. This result accords with theory because a high cost of equity reflects severe external financing constraints and elevated investor risk premia, which limit firms' ability to convert improved informational signals into tangible funding for long-horizon, uncertain projects such as R&D. Moreover, high equity capital costs are frequently associated with investor short-termism, which further reduces the likelihood that ESG disclosure will translate into sustained R&D financing. This result supports Hypothesis 3.

To assess the robustness of the above moderation effects, column (3) includes both the interaction term for greenwashing and the interaction term for the cost of equity. After controlling for both interactions, the coefficients on $ESG \times GW$ and $ESG \times COE$ are 0.0072 and -0.0037, respectively; both remain significant at the 1% level and maintain the same directions observed in the separate regressions. This indicates that the positive moderating effect of greenwashing behavior and the negative moderating effect of equity capital cost can coexist and are not mutually exclusive. In other words, firms may experience an enhanced effect of ESG disclosure on R&D investment due to greenwashing behavior or a weakened effect due to high cost of equity. These two forces operate in parallel within the same model, further corroborating Hypotheses 2 and 3.

Table 3. Regression results for Hypothesis 2 & 3.

	Hypothesis 2	Hypothesis 3	Combined model
<i>ESG</i>	0.0149***	0.0619***	0.0567***
<i>ESG</i> × <i>GW</i>	0.0079***	/	0.0072***
<i>ESG</i> × <i>COE</i>	/	-0.0038***	-0.0037***
<i>GW</i>	-0.3900***	-0.0986**	-0.3747***
<i>COE</i>	0.0117	0.1513***	0.1475***
<i>INST</i>	-0.0140**	-0.0108**	-0.0109**
<i>A</i>	0.0645	0.0855	0.0775
<i>LEV</i>	-0.0354***	-0.0346***	-0.0349***
<i>ROA</i>	-0.0087	-0.0084	-0.0082
<i>GROWTH</i>	-0.0080***	-0.0080***	-0.0080***
<i>CF</i>	-0.0173***	-0.0168***	-0.0169***
<i>BM</i>	-0.0027	-0.0023	-0.0022
<i>IND</i>	0.0270**	0.0275**	0.0274**
<i>TSH1</i>	0.0003	-0.0005	-0.0004
<i>AGE</i>	-0.0195	-0.0312	-0.0220
<i>Year FE</i>	Yes	Yes	Yes
<i>Firm FE</i>	Yes	Yes	Yes
<i>F</i>	8.7972	9.2806	8.9374
<i>R-squared</i>	0.0315	0.0332	0.0342
<i>N</i>	4803	4803	4803

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

5 Conclusion and Policy Implications

This study uses a sample of Chinese A-share listed firms from 2014 to 2024 to systematically examine the effect and mechanisms through which corporate ESG disclosure influences R&D investment, and to analyze the moderating roles of greenwashing behavior and the cost of equity. The results indicate that ESG disclosure significantly promotes corporate R&D investment. This innovation-enhancing effect is more pronounced among non-SOEs and firms with high institutional ownership, suggesting that ownership structure and external governance are important contextual determinants of ESG-driven innovation. Moderation tests show that greenwashing positively moderates the ESG-R&D relationship, whereas the cost of equity negatively moderates this relationship.

Policy implications follow from these findings. First, regulators should strengthen the ESG information disclosure regime and enhance oversight of disclosure quality. Policymakers ought to accelerate the standardization of ESG disclosure standards and consider moving from voluntary to mandatory disclosure, expanding coverage in particular for non-SOEs. An ESG disclosure quality assessment framework and third-party verification mechanism should be established, and greenwashing should be subject to strict enforcement. Firms should be guided to orient ESG disclosure toward value creation rather than formal compliance, ensuring authenticity and comparability of nonfinancial information.

Second, given the comparatively weak innovation incentive effect of ESG disclosure in SOEs, performance evaluation systems for them should place greater weight on R&D investment and innovation output indicators, and link ESG performance to managerial compensation and promotion criteria to prevent ESG practices from becoming purely symbolic. For non-SOEs, policymakers should expand green finance support and reduce financing costs through instruments such as green loans and interest subsidies for green bonds, thereby amplifying the signaling value of ESG disclosure and stimulating innovation.

Third, authorities should leverage institutional investors' governance capacity and seek to lower the cost of equity capital to facilitate conversion of ESG disclosure into innovation financing. Regulatory reforms that encourage institutional investor engagement in corporate governance, promote long-term investment orientations, and curb short-term speculative behavior can help stabilize equity financing costs and reduce market-driven disruptions to innovation spending. Concurrently, a certification and rating framework for ESG investment products should be developed to limit the potential for institutional investors to drive greenwashing [14]. Investor education and the cultivation of institutional investor groups that prioritize long-term value will improve market recognition and pricing of credible ESG disclosures and enhance the efficiency with which ESG advantages are translated into lower financing costs.

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