



## The Impact of Firm Deviant Strategy on Greenwashing

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**SUMMARY:** *As ESG practices shift from "voluntary disclosure" to "regulatory compliance," companies are facing dual pressures from stakeholder demands for strict ESG transparency and short-term profit driven motivations. This article aims to explore the causes of corporate greenwashing and provide theoretical support for research on greenwashing governance. Firstly, based on the resource-based theory, ESG information disclosure is regarded as a strategic resource acquisition behavior, and a two-way fixed effects econometric model is constructed. Secondly, this article also examines the impact of strategic differences on greenwashing behavior under different market environments, enterprise sizes, property rights, regional distributions, and industry types through heterogeneity analysis. Research has found that significant differences in corporate strategy positively drive greenwashing behavior, and this association remains robust even after controlling for municipalities, fixed industries, and lagged variables. Heterogeneity testing shows that strategic heterogeneity has a more significant impact on greenwashing behavior in samples of high market competition, large-scale, non-state-owned property structure, east-west regional distribution, and manufacturing enterprises. In addition, the increase in media attention amplifies the correlation between strategic heterogeneity and greenwashing behavior, and has a significant positive moderating effect.*

**KEYWORDS:** *Corporate strategy; Greenwashing behavior; ESG information disclosure; Heterogeneity analysis; Strategic heterogeneity; Market environments; Media attention*

## 1 Introduction

Driven by the global climate governance and sustainable development wave, the concept of Environmental, Social, and Governance (ESG) has become a crucial benchmark for measuring a company's sustainable development capabilities. ESG information disclosure is not only a core pathway for companies to respond to national policies but also a key resource for gaining trust in capital markets and achieving long-term value creation [1].

However, as ESG practices transition from "voluntary disclosure" to "regulatory compliance," companies face dual pressure from stakeholder demands for strict ESG transparency and their own short-term profit-driven motivations, leading to frequent "greenwashing" practices [2]. Such behaviors involve selectively disclosing environmental performance, exaggerating green commitments, or fabricating low-carbon achievements to conceal actual negative environmental impacts, creating a false image of "say one thing, do

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another" social responsibility. This phenomenon will impact economic growth and social stability [3]. In such a situation, investigating corporate ESG greenwashing has become an urgent priority in today's society.

This study approaches the internal decision-making perspective of corporate strategic differentiation, providing a new theoretical framework for researching the causes of greenwashing. Existing literature primarily focuses on the driving role of external institutional pressures or stakeholder demands on greenwashing behavior, with less attention paid to how differences in corporate strategic positioning can influence the authenticity of ESG practices through internal resource allocation logic [4]. Based on resource-based theory, this paper views ESG information disclosure as a strategic resource acquisition behavior, revealing that firms with higher strategic differentiation tend to allocate limited resources more towards "high visibility, low substantive cost" greenwashing activities rather than long-term environmental technological innovation.

The moderating effect of media attention indicates that while media attention may suppress corporate environmental violations through reputation mechanisms, high exposure still exacerbates the legitimacy anxiety of strategically deviating firms, prompting them to engage in more intensive environmental information manipulation to offset the potential risks of public opinion oversight.

Furthermore, based on the heterogeneity analysis of property rights nature and regional marketization levels, this study identifies the boundary role of institutional context in the relationship between corporate strategic choices and greenwashing behavior. Firms in highly competitive markets may use green image shaping as a lever for strategic breakthroughs to gain differential advantages. State-owned enterprises, due to policy compliance pressures and resource endowment advantages, exhibit lower probabilities of greenwashing [5]. Meanwhile, regions with higher marketization levels weaken the driving effect of strategic divergence on greenwashing through improved information disclosure systems. These conclusions not only enrich the contextualized research of institutional theory in the ESG field but also provide theoretical support for the formulation of differentiated regulatory policies, highlighting the importance of the "strategy—institution" matching perspective in greenwashing governance research.

## 2 Literature Review

### 2.1 Deviant strategy and greenwashing

Highly differentiated strategic enterprises, due to the lack of industry experience for reference, need to bear higher costs of trial and error and risk premiums [6]. In this situation, management tends to prioritize the supply of core business resources, cutting back on long-term investments such as environmental governance.

Public environmental awareness drives the growth of green consumption demand, and differentiated strategy enterprises try to obtain market premiums through environmental protection labels. However, the inherent resource consumption characteristics of differentiated strategies are in contradiction with the capital-intensive nature of environmental protection investment. Substantial environmental protection transformation requires continuous capital injection, while differentiated enterprises face restricted financing channels due to high performance volatility.

This tension gives rise to strategic greenwashing behaviors—enterprises substitute low-cost green marketing for high-cost environmental practices, exploiting information asymmetry to gain reputation premiums [7]. The low execution cost of greenwashing and the high market

returns form a self-reinforcing incentive cycle, making it easier for resource-constrained differentiated strategy enterprises to fall into the "pseudo-responsibility" trap.

The theory of asymmetric information points out that market participants form unequal power due to differences in information acquisition ability, which in turn triggers adverse selection and moral hazard. Differentiated strategies make it difficult to decode the characteristics of enterprise operations in the industry reference framework, external stakeholders cannot infer the true situation of the enterprise through peer comparison, and the cost of information verification significantly increases [8].

Information asymmetry can catalyze greenwashing behavior. When there is adverse selection in the green market, green products are treated as trust goods. When strategic differentiation drives up capital costs, companies may systemically beautify environmental performance to maintain financing capacity, using information asymmetry to conceal substantial contradictions [9].

When a company adopts a high differentiation strategy, its business model and resource allocation significantly deviate from industry norms, leading to cognitive barriers for external stakeholders. Reference [10] found that non-mainstream strategies are more likely to trigger legitimacy concerns—investors increase risk premiums due to information opacity.

H1: The degree of corporate strategic difference has a positive impact on corporate greenwashing behavior.

## 2.2 Moderating Effects

Media attention as an informal governance tool influences corporate decision-making through two pathways: reputation constraint and information dissemination. Media, through information screening and dissemination, reduces investors' information processing costs [11]. Reference [12] point out that when media reports are viewed as a reliable source, their content directly affects capital allocation. The schematic diagram of the impact of differences in corporate strategy on greenwashing behavior is shown in Figure 1.

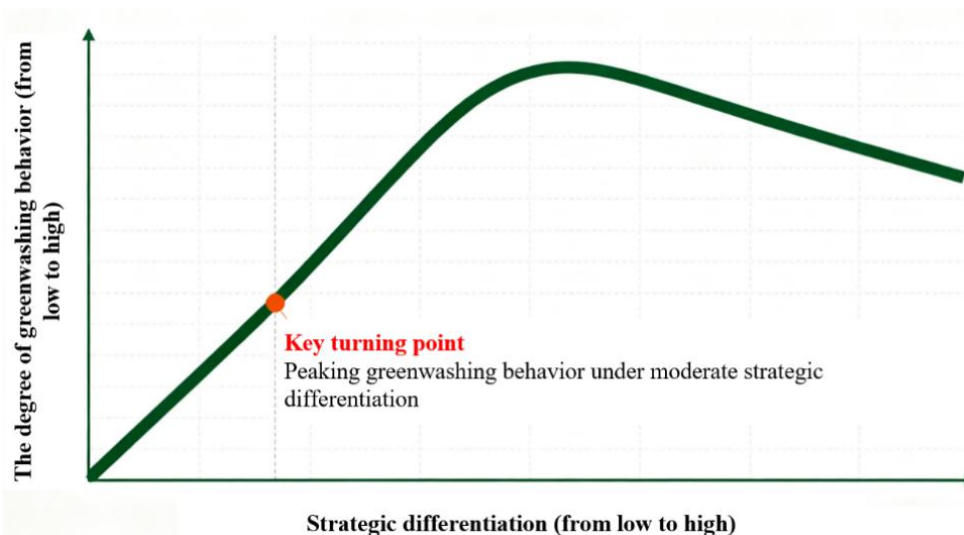


Figure 1: The impact of differences in corporate strategy on greenwashing behavior

In a high media attention environment, the legitimacy disputes of firms with differentiated strategies are more likely to be exposed, forcing management to weigh the greenwashing risks. However, when the strategic differentiation of a firm is high, its competitive strategies that deviate from industry norms often require a more prominent market positioning, and the

environmental image becomes an important carrier of differentiation. At this point, the increase in media attention amplifies the public exposure of the firm's environmental information disclosure, forming a dual effect. B. Based on this, the hypothesis is proposed:

H2a: Media attention will weaken the relationship between corporate strategic differentiation and greenwashing behavior, i.e., it will play a negative moderating role.

H2b: Media attention will strengthen the relationship between corporate strategic differentiation and greenwashing behavior, i.e., it will play a positive moderating role.

## 3 Research Design

### 3.1 Sample Selection

This paper selects Chinese A-share listed companies from the Shanghai and Shenzhen stock exchanges between 2012 and 2022 as the initial research sample. The data sources include the Bloomberg ESG database, Huazheng ESG database, annual reports of listed companies, the CNRDS database, and the CSMAR database. To ensure data quality and the reliability of conclusions, the following steps are taken for screening and preprocessing: (1) Exclude ST/\*ST listed companies, as their financial anomalies or delisting risk warnings may interfere with the analysis of normal operational characteristics; (2) Remove financial industry enterprises, as their business models and regulatory frameworks are significantly different from other industries; (3) Apply Winsorize trimming at the 1% percentile to continuous variables to reduce the potential bias of outliers on regression results.

After the above processing, a total of 7,663 valid observations are obtained. The empirical analysis uses STATA for testing, supplemented by EXCEL for basic data cleaning and descriptive statistics.

### 3.2 Variable Design

(1) Explanatory Variables. This article adopts the operational definition by Reference [13], which states that strategic deviance reflects the degree of dispersion of a firm's resource allocation and market positioning relative to the industry average. This definition method not only retains the core focus of strategic management theory on "deviance from industry norms", but also achieves an observable and verifiable empirical transformation through financial accounting indicators, providing a theoretical bridge to reveal the intrinsic connection between strategic decision-making and greenwashing behavior. Specifically, the deviant Strategy is used to measure the degree of deviation of a firm's strategy from industry norms, and the six key domain indicators selected are believed to reflect the firm's strategic direction, i.e., the implementation mode of the firm's resource allocation.

First, calculate six strategic dimension indicators: (1) Advertising and Promotion Expenditure (Selling Expenses/Operating Revenue); (2) R&D Investment (Net Intangible Assets/Operating Revenue); (3) Capital Intensity (Fixed Assets/Number of Employees); (4) Degree of Fixed Asset Replacement (Net Fixed Assets/Gross Fixed Assets); (5) Administrative Expense Expenditure (Administrative Expenses/Operating Revenue); (6) Corporate Financial Leverage ((Short-term Borrowings + Long-term Borrowings + Bonds Payable)/Book Value of Equity).

Second, for each strategic dimension indicator X, calculate the difference between the indicator value of sample firm i in year t and the industry average for the same industry j (classified according to CSRC standards) in the same year; divide the above difference by the annual standard deviation of the indicator within the industry to eliminate dimensional differences and convert it into comparable values  $Z_{it}$ :

$$Z_{it} = \frac{X_{it} - \bar{X}_{jt}}{\sigma_{ijt}} \quad (1)$$

Finally, take the absolute value of  $Z_{it}$  to eliminate the influence of deviation direction, sum the standardized absolute values of the six dimensions, and take the arithmetic mean to obtain the Strategic Deviation Indicator  $DS_{it}$  for firm  $i$  in year  $t$ .

$$DS_{it} = \frac{1}{6} \sum_{j=1}^6 |Z_{it}| \quad (2)$$

(2) Dependent Variable. To reduce subjective judgment bias, objective quantitative indicators proposed by Reference [14], and others:

$$GW_{it} = \left( \frac{ESG_{dis,it} - \overline{ESG}_{dis,jt}}{\sigma_{dis,ijt}} \right) - \left( \frac{ESG_{rat,it} - \overline{ESG}_{rat,jt}}{\sigma_{rat,ijt}} \right) \quad (3)$$

ESG disclosure score ( $ESG_{disclosure}$ ) adopts the Bloomberg ESG Disclosure Scores, which evaluates the information transparency and breadth of corporate ESG reporting through quantification. ESG performance score ( $ESG_{rating}$ ) is derived from the ESG performance rating under the Huazheng ESG evaluation system, where the Huazheng system, based on the characteristics of China's capital market, has constructed an evaluation framework adapted to the ESG practices of domestic listed companies.

This paper follows the objective quantitative indicators proposed by Reference [15], and others, transforming them:

$$GW_{it} = \left( \frac{ER_{dis,it} - \overline{ER}_{dis,jt}}{\sigma_{dis,ijt}} \right) - \left( \frac{ER_{rat,it} - \overline{ER}_{rat,jt}}{\sigma_{rat,ijt}} \right) \quad (4)$$

The environmental disclosure score ( $ER_{disclosure}$ ) adopts the score from the Environment section of the Bloomberg ESG Disclosure Scores. The environmental performance score ( $ER_{rating}$ ) is derived from the Environment section of the Huazheng ESG evaluation system.  $\overline{ER}_{dis}$  and  $\overline{ER}_{rat}$  represents the average environmental disclosure and performance scores in industry  $j$  in year  $t$ , and  $\sigma_{dis}$  and  $\sigma_{rat}$  represents the standard deviation of environmental disclosure and performance scores within the same industry in the same year.

(3) Adjusting Variables. Media Attention (Media), adopts the natural logarithm of the total number of times a company appears in the titles or content of financial news from newspapers, financial news online, and financial news in the CNRDS database as the proxy variable for media attention.

(4) Control Variables. Referencing existing research designs, this paper includes control variables related to corporate characteristics and governance structure in the model to exclude potential confounding effects. The model also introduces annual dummy variables (Year) and industry dummy variables (Industry), employing a two-way fixed effects approach to control for temporal trends and industry heterogeneity.

The variable definitions used in this article are shown in Table 1.

Table 1: Summary of Variables

Variable Type	Variable Name	Variable Symbol	Variable definition
Explanatory variable	Deviant strategy	DS	The arithmetic mean of the sum of standardized absolute values across six dimensions
Dependent variable	Greenwashing	GW	The arithmetic mean of the sum of absolute values after standardizing environmental disclosure and performance scores
Moderating variable	Media attention	Media	The natural logarithm of the total number of times a company appears in news headlines or content
	Age at listing	Age	Years since the company went public
	Enterprise size	Size	Ln (Total assets at the end of the period)
Control variables	Net profit margin of total assets	Roa	Net profit / Total assets
	Tobin's Q	Tobin	Market value of the enterprise at the end of the year divided by total assets at the end of the year
	Shareholding of the top five shareholders	Top5	Shareholding ratio of the top five shareholders
	Total debt to asset ratio	Debt	Total debt / Total assets
	Net profit growth rate	Netprofit	(Current period net profit - previous period net profit) / previous period net profit

### 3.3 Model Construction

This paper sets up a panel regression model to test Hypothesis 1 regarding the impact of corporate deviant strategy (DS) on greenwashing (GW). The baseline model is as follows:

$$GW_{it} = \beta_0 + \beta_1 DS_{it} + \beta_2 C_{it} + Year_{it} + Industry_{it} + \epsilon_{it} \quad (6)$$

where  $GW_{it}$  represents the "greenwashing" behavior of firm  $i$  in year  $t$ ,  $DS_{it}$  is the strategic differentiation index of firm  $i$  in year  $t$ ,  $C_{it}$  includes characteristic variables, Year and Industry respectively represent year and industry fixed effects, and  $\beta_1$  is the key coefficient of interest. If its estimated value is significantly positive, it supports Hypothesis H1, that is, corporate strategic differentiation has a positive impact on corporate greenwashing behavior.

To further explore the moderating role of media attention, i.e., Hypothesis H2, the following model is constructed:

$$GW_{it} = \gamma_0 + \gamma_1 DS_{it} + \gamma_2 Media_{it} + \gamma_3 Media_{it} * DS_{it} + \gamma_4 C_{it} + Year_{it} + Industry_{it} + \epsilon_{it} \quad (7)$$

where  $Media_{it}$  represents the media attention of enterprise  $i$  in year  $t$ ,  $Media_{it} * DS_{it}$  represents the interaction term between strategic differentiation and media attention, and the remaining variables are the same as above.  $\gamma_3$  is the core attention coefficient. If its estimated value has the opposite sign to  $\gamma_1$ , it supports hypothesis H2a, that is, media attention will

strengthen the relationship between enterprise strategic differentiation and greenwashing behavior, playing a positive moderating role; otherwise, it supports hypothesis H2b, that is, media attention will weaken the relationship between enterprise strategic differentiation and greenwashing behavior, playing a negative moderating role.

## 4 Empirical Testing

### 4.1 Regression Analysis

(1) Descriptive Statistics. Descriptive statistics were conducted on the main variables of this study, with the results shown in **Table 2**. The mean of GW is -0.456, with a standard deviation of 1.281, and a range of 11.23 from the minimum -5.54 to the maximum 5.69, indicating significant differences in greenwashing behavior among sample enterprises. The median of -0.508 is lower than the mean, and the distribution is left-skewed (mean > median), suggesting that some enterprises exhibit extreme "pseudo-environmental" behavior, while most enterprises show relatively mild greenwashing extent.

*Table 2: Descriptive Statistical Results*

VarName	Obs	Mean	SD	Min	Median	Max	Description
GW	7663	-0.457	1.281	-5.546	-0.508	5.691	Greenwashing
DS	7663	0.637	0.302	0.118	0.568	3.032	Strategic Differences
Media	7663	4.590	1.216	0	4.710	8.905	Media attention
age	7663	13.844	7.165	0	14	31	Age at listing
size	7663	23.436	1.351	19.552	23.327	28.637	Enterprise size
roa	7663	0.049	0.063	-0.965	0.041	0.604	Net profit of total assets
tobin	7663	1.982	1.709	0.641	1.454	29.167	Tobin's Q
top5	7663	0.538	0.201	0.201	0.509	0.991	Shareholding of the top five shareholders
debt	7663	0.475	0.190	0.008	0.489	1.698	Total debt to asset ratio
netprofit	7663	-0.002	0.039	-0.574	0.001	0.205	Net profit growth rate

The mean of strategic differentiation (DS) is 0.636 (standard deviation 0.302), with a median of 0.568 and a maximum value of 3.032, indicating that most enterprises' strategies are close to industry conventions ( $DS < 1$ ), but there are a few high-differentiation enterprises ( $DS > 2$ ) whose strategic combinations significantly deviate from industry norms.

The mean of media attention (Media) is 4.589 (standard deviation 1.216), covering a range from 0 to 8.905, indicating that some enterprises have been under the media spotlight for a long time, while some small and medium-sized enterprises have extremely low media exposure.

(2) Correlation Analysis. **Table 3** shows the results of the correlation analysis between variables. The correlation coefficient between DS and GW is 0.073, significantly positive, which initially supports hypothesis H1—that higher strategic differentiation leads to stronger corporate greenwashing tendencies. However, the small absolute value of the coefficient suggests that the relationship between the two may be influenced by the moderating effects of other variables, requiring further examination of the net effect through regression models.

Table 3: Correlation Analysis Results

	GW	DS	media	age	size	roa	tobin
GW	1.000						
DS	0.073***	1.000					
media	0.071***	-0.022*	1.000				
age	-0.056***	0.066***	-0.163***	1.000			
size	0.095***	0.091***	0.198***	0.204***	1.000		
roa	0.051***	-0.132***	0.105***	-0.149***	-0.078***	1.000	
tobin	0.038***	-0.0180	0.143***	-0.159***	-0.321***	0.350***	1.000
top5	-0.075***	0.032***	-0.107***	0.136***	0.0120	-0.055***	-0.097***
debt	-0.025**	0.149***	0.071***	0.190***	0.502***	-0.442***	-0.353***
netprofit	0.020*	-0.109***	0.0040	-0.0130	0.031***	0.430***	0.050***
	top5	debt	netprofit				
top5	1.000						
debt	0.075***	1.000					
netprofit	-0.042***	-0.130***	1.000				

Note: \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Additionally, the correlation coefficient between Media and GW is 0.071, indicating that firms with high media exposure may engage in more frequent greenwashing behavior, reflecting the "supervision paradox"—high exposure can both suppress greenwashing and force companies to manipulate information to cope with public opinion pressure. Further research through models is still needed.

(3) Collinearity Analysis. According to **Table 4**, there are no serious problems of multicollinearity in the overall data of this study and the model.

Table 4: Collinearity Analysis Results

Variable	VIF	1/VIF
debt	1.740	0.574
roa	1.700	0.586
size	1.500	0.668
tobin	1.300	0.767
netprofit	1.260	0.796
age	1.090	0.918
DS	1.040	0.961
top5	1.030	0.969
Mean VIF	1.330	

(4) Model Validation. Based on the three statistical test results in **Table 5**, this paper systematically evaluates the applicability of the panel data model to ensure the robustness of the empirical conclusions, and finally selects the fixed effects model.

Table 5: Results of Model Selection

Test Methods	Purpose of inspection	Inspection value	p-value	Conclusion
LM test	Mixed OLS or Random Effects	5704.47	0.0000	Random Effects
F test	Mixed OLS or Fixed Effects	6.24	0.0000	Fixed Effects
Hausman test	Fixed Effects or Random Effects	29.82	0.0002	Fixed Effects

(5) Main regression analysis. The regression results of strategic differentiation (DS) on greenwashing behavior (GW) are shown in **Table 6**.

Table 6: Main regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	Bidirectional fixed	Bidirectional fixed	Individual fixed	Time fixed	Random effects	OLS
DS	0.193*** (2.765)	0.220*** (3.068)	0.213*** (2.990)	0.339*** (6.976)	0.255*** (4.418)	0.336*** (6.928)
age		0.018** (2.339)	0.014** (2.385)	-0.012*** (-5.885)	-0.007*** (-2.601)	-0.010*** (-5.206)
size		-0.039 (-0.993)	-0.036 (-0.928)	0.134*** (9.887)	0.087*** (4.351)	0.145*** (11.174)
roa		0.923*** (2.965)	0.881*** (2.848)	0.264 (0.882)	0.637** (2.269)	0.218 (0.732)
tobin		0.002 (0.194)	0.006 (0.579)	0.025*** (2.585)	0.021** (2.214)	0.031*** (3.244)
top5		-0.302** (-2.171)	-0.298** (-2.163)	-0.347*** (-4.708)	-0.420*** (-4.236)	-0.384*** (-5.293)
debt		0.299* (1.734)	0.286* (1.663)	-0.475*** (-4.696)	-0.210* (-1.666)	-0.523*** (-5.229)
netprofit		0.081 (0.231)	0.048 (0.139)	0.156 (0.376)	0.049 (0.146)	0.136 (0.329)
_cons	-0.671*** (-10.949)	0.032 (0.037)	0.034 (0.040)	-3.284*** (-10.839)	-2.232*** (-5.017)	-3.550*** (-12.199)
id	Yes	Yes	Yes	Yes	Yes	Yes
time	Yes	Yes	Yes	Yes	Yes	Yes
N	7663	7663	7663	7663	7663	7663
R <sup>2</sup>	0.003	0.005	0.005	0.034	-	0.032

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

## 4.2 Moderation Effect Analysis

The empirical results indicate that corporate strategic differentiation (DS) has a significant positive driving effect on greenwashing behavior (GW), and this conclusion exhibits high robustness across different model specifications. The bidirectional fixed effects model shows that the coefficient of DS is significantly positive at the 1% level, indicating that firms with

strategic deviations from industry conventional models are more inclined to engage in environmental information manipulation. Through comparative tests of individual fixed effects, time fixed effects, and random effects models, the significance level and direction of effect of DS remain consistent, verifying the reliability of the core hypothesis H1. The analysis of control variables reveals that the ownership proportion of the top five shareholders (Top5) is significantly negatively correlated with greenwashing behavior, confirming the constraint effect of large shareholder governance on managerial opportunistic behavior.

The empirical results in **Table 7** show that media attention (Media) significantly strengthens the driving effect of strategic divergence (DS) on greenwashing behavior (GW), verifying the moderating mechanism of external supervision pressure on the "strategic deviation—greenwashing" relationship. The bidirectional fixed-effects model indicates that the interaction term coefficient between DS and Media is significantly positive at the 10% level, suggesting that when firms are in a high media exposure environment, strategic divergence will positively influence greenwashing behavior. This finding supports the "supervision paradox" hypothesis—that although media attention may suppress corporate environmental violations through reputation mechanisms, high exposure intensifies the legitimacy anxiety of strategically deviating firms, prompting them to engage in more intensive environmental information manipulation to offset the potential risks of public opinion supervision, ultimately verifying H2b hypothesis.

*Table 7: Regression results of media attention moderating analysis*

	(1)	(2)
DS	0.194***	0.221***
	(2.778)	(3.083)
media	0.046***	0.041**
	(2.685)	(2.337)
DS*media	0.070*	0.070*
	(1.702)	(1.696)
age		0.019**
		(2.517)
size		-0.045
		(-1.157)
roa		0.874***
		(2.805)
tobin		-0.003
		(-0.236)
top5		-0.292**
		(-2.100)
debt		0.278
		(1.609)
netprofit		0.089
		(0.254)
_cons	-0.097**	-0.014
	(-2.366)	(-0.448)
id	Yes	Yes
time	Yes	Yes
N	7663	7663
R <sup>2</sup>	0.005	0.007

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

### 4.3 Robustness Test

(1) Exclude Municipality Cities. By excluding the samples of enterprises from the four direct-controlled municipalities (Beijing, Shanghai, Tianjin, and Chongqing) (a total of 1,866 observations reduced), the sample range is adjusted to test the sensitivity of the sample. According to the results in column (1) of **Table 7**, the DS coefficient remains significantly positive ( $\beta=0.252^{***}$ ), consistent with the baseline model results, indicating that the sample used in this study has low sensitivity.

(2) Lag the Variables by One Period. By lagging the explanatory variable (SDE) and control variables by one period, the reverse causality problem is mitigated. According to the results in column (3) of **Table 8**, the DS coefficient is still significant ( $\beta=0.184^{**}$ ).

*Table 8: robustness test results*

	(1)	(2)
	Excluding municipalities	Variable lagged by one period
DS	0.252***	0.184**
	(3.014)	(2.044)
age	0.015*	0.026***
	(1.733)	(2.701)
size	-0.057	-0.039
	(-1.310)	(-0.782)
roa	1.109***	-0.158
	(3.183)	(-0.311)
tobin	-0.004	0.009
	(-0.339)	(0.607)
top5	-0.385**	-0.208
	(-2.391)	(-1.259)
debt	0.288	0.315
	(1.428)	(1.464)
netprofit	-0.058	0.195
	(-0.151)	(0.221)
id	Yes	Yes
time	Yes	Yes
industry	No	No
N	5797	5900
R <sup>2</sup>	0.007	0.005

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

Three tests respectively by adjusting the sample range, controlling industry heterogeneity, and lagging variables by one period, systematically ruled out the interference of policy privileges of municipalities directly under the Central Government, inherent industry characteristics, and reverse causality on the core conclusions. Finally, according to the results, the conclusion of this study that "strategic differences drive greenwashing" has cross-situational robustness.

(3) Instrumental Variable Method. Considering the impact of endogeneity and the potential inertia in corporate strategic adjustments, the strategic difference in the previous period is highly correlated with the current DS. Meanwhile, lagged variables are not affected by current greenwashing behavior or unobservable time-varying factors, satisfying the exclusion

restriction. Therefore, the explanatory variable (DS) is lagged by one period and used as an instrumental variable in the regression model to obtain the results in the following **Table 9**.

The regression results show that the coefficient of strategic difference is significantly positive at the 5% level ( $\beta=0.442^{**}$ ), showing some improvement compared to the baseline fixed-effects model, indicating that ignoring endogeneity would severely underestimate the driving effect of strategic difference on greenwashing behavior. Similarly, this regression result supports the theoretical hypothesis of H1.

*Table 9: Results of Instrumental Variable Method Test*

	(1)
DS	0.442**
	(2.049)
age	0.036
	(0.596)
size	-0.012
	(-0.222)
roa	0.701*
	(1.663)
tobin	0.016
	(1.055)
top5	-0.154
	(-0.905)
debt	0.172
	(0.766)
netprofit	0.488
	(0.985)
id	Yes
time	Yes
Underidentification test	856.304(p=0.0000)
Weak identification test	1040.536(16.38)
N	5777
R <sup>2</sup>	0.003

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

#### 4.4 Heterogeneity Analysis

(1) Degree of Market Competition. Based on the market structure classification using the Herfindahl-Hirschman Index (HHI), firms in highly concentrated industries ( $HHI > 0.18$ ) typically face lower competitive pressure and higher entry barriers, whereas markets with high competition ( $HHI \leq 0.18$ ) often require greater advantages to establish a foothold in the industry. According to the results in Table 5-10, the positive effect of strategic differentiation on greenwashing behavior did not pass the significance test in the high market concentration sample, while the highly competitive group showed a highly significant positive correlation ( $\beta = 0.341^{***}$ ). This divergence may stem from the relatively limited legitimacy challenges resulting from corporate strategic deviations in monopolistic market structures, as well as the diminishing marginal returns from strategic deviations, thereby reducing the motivation for greenwashing. Conversely, in a fully competitive environment, firms with strategic differentiation may use green image shaping as a lever for strategic breakthroughs to gain

competitive advantages, and this competitive ecosystem amplifies the tension between strategic differentiation and environmental performance.

(2) Firm Size. Firms of different sizes exhibit varying resource allocation capabilities and public opinion influence, and their environmental governance behaviors may be subject to different levels of social supervision. According to the results in **Table 10**, large-scale firms have a more economically significant DS coefficient ( $\beta = 0.317$ ,  $t = 2.885$ ) compared to medium and small-scale firms ( $\beta = 0.204$ ,  $t = 1.970$ ). This may be due to the cost thinning effect of economies of scale in environmental governance, which makes it easier for actual environmental investment to deviate from strategic expansion speed, leading large-scale firms to choose to embellish environmental disclosure information.

*Table 10: Analysis Results of Market Competition Degree and Firm Size Heterogeneity*

	(1)	(2)	(3)	(4)
	High market concentration	High degree of market competition	Large-scale	Small-scale
DS	0.096	0.341***	0.317***	0.204**
	(0.906)	(3.372)	(2.885)	(1.970)
age	0.060***	0.004	0.037***	-0.001
	(4.611)	(0.447)	(2.992)	(-0.156)
size	-0.177***	-0.021	-0.112	0.002
	(-2.675)	(-0.401)	(-1.508)	(0.041)
roa	1.305***	0.725	1.190**	0.520
	(2.810)	(1.643)	(2.035)	(1.401)
tobin	-0.006	0.015	-0.010	0.020
	(-0.399)	(0.805)	(-0.357)	(1.482)
top5	-0.025	-0.442**	0.004	-0.668***
	(-0.111)	(-2.363)	(0.021)	(-3.268)
debt	-0.103	0.644***	0.225	0.305
	(-0.369)	(2.756)	(0.719)	(1.406)
netprofit	-0.239	0.298	-0.184	0.349
	(-0.413)	(0.636)	(-0.374)	(0.642)
_cons	2.966**	-0.442	1.269	-0.382
	(2.031)	(-0.375)	(0.7567)	(-0.278)
id	Yes	Yes	Yes	Yes
time	Yes	Yes	Yes	Yes
N	2907	4688	3831	3832
R <sup>2</sup>	0.017	0.009	0.016	0.013

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

(3) Regional Division. Based on the characteristics of unbalanced regional development in China, this study analyzes the varying degrees of the impact of strategic differentiation on greenwashing behavior in the eastern, central, and western regions. The specific results are shown in **Table 11**. In the eastern region, where marketization is high and environmental regulations are strict, the DS coefficient is significantly positive at the 5% level, reflecting that intensive media supervision and a mature rule of law environment put companies under the dual pressure of "high regulation—high exposure," and companies with high strategic differentiation may use greenwashing to enhance their legitimacy. In contrast, the western

region shows a stronger driving effect, with its coefficient ( $\beta=0.392^{**}$ ,  $t=2.15$ ) significantly larger than those in other regions, highlighting the logic of "regulatory arbitrage" in a weak institutional environment. Under the context of flexible environmental enforcement and lack of public supervision, companies with strategic deviations can quickly obtain policy dividends through low-cost greenwashing without bearing substantive innovation risks. However, the central region does not show significant characteristics.

*Table 11: Analysis Results of Regional Heterogeneity*

	(1)	(2)	(3)
	East	Central	West
DS	0.207**	0.1309	0.3925**
	(2.425)	(0.6502)	(2.1500)
age	0.022**	-0.0037	0.0337*
	(2.315)	(-0.2154)	(1.6973)
size	0.018	-0.0812	-0.3734***
	(0.386)	(-0.9043)	(-3.4518)
roa	0.583	1.7405*	1.8024***
	(1.433)	(1.874)	(2.944)
tobin	0.014	-0.026	-0.038
	(1.028)	(-0.865)	(-1.038)
top5	-0.314*	-0.439	-0.419
	(-1.830)	(-1.316)	(-1.187)
debt	0.097	0.939**	0.473
	(0.466)	(2.140)	(1.058)
netprofit	-0.104	-0.520	1.317*
	(-0.180)	(-0.845)	(1.873)
_cons	-1.318	1.196	7.622***
	(-1.234)	(0.624)	(3.257)
id	Yes	Yes	Yes
time	Yes	Yes	Yes
N	5299	1319	1045
R <sup>2</sup>	0.009	0.015	0.040

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

(4) Nature of Property Rights. According to the data shown in **Table 11**, the DS coefficient ( $\beta=0.257^{**}$ ) of non-SOE-controlled enterprises is higher than that of SOEs ( $\beta=0.207^{**}$ ), which may be because non-SOEs have weaker political connections and higher dependence on market reputation, making them more inclined to use greenwashing to compensate for legitimacy gaps when they deviate from strategy, forcing them to use environmental reports to beautify and alleviate investor concerns. SOEs, relying on policy protection and budget soft constraints, have relatively lower marginal demand for greenwashing.

(5) Industry Type. From an industry perspective, manufacturing enterprises generally exhibit characteristics such as heavy asset operations, high standardization of production processes, and strong environmental regulatory sensitivity. Their environmental investments often require substantial equipment upgrades and process modifications. In contrast, non-manufacturing enterprises rely more on brand reputation and customer relationship maintenance, with relatively flexible environmental governance costs. This may lead to both

types of enterprises choosing different greenwashing paths when facing strategic deviation pressure.

According to the regression data in column (3) of **Table 12**, the positive impact of strategic divergence (DS) on greenwashing behavior is more significant in manufacturing samples ( $\beta=0.239$ ,  $p<0.01$ ), while the coefficient for non-manufacturing remains positively correlated but with reduced significance ( $\beta=0.191$ ,  $p<0.1$ ). This divergence may stem from the fact that manufacturing enterprises face stricter environmental compliance reviews and higher pollution control costs during strategic differentiation transformation. When actual environmental investments fail to match the speed of strategic expansion, management is more inclined to use information manipulation techniques to maintain a green image. It is worth noting that the economic significance of the DS coefficient in the manufacturing sector is higher than in the non-manufacturing sector, and the t-value reaches 2.5371, indicating that the contradiction between strategic decisions and environmental disclosure behavior in this industry exhibits stronger statistical robustness.

*Table 12: Analysis Results of Property Rights and Industry Heterogeneity*

	(1)	(2)	(3)	(4)
	State-owned enterprise	Non-state-owned enterprise	Manufacturing	Non-manufacturing
DS	0.207** (2.053)	0.257** (2.458)	0.239** (2.537)	0.191* (1.653)
age	0.040*** (3.894)	-0.016 (-1.311)	0.005 (0.508)	0.037*** (2.887)
size	-0.105* (-1.828)	0.020 (0.346)	-0.046 (-0.896)	-0.008 (-0.116)
roa	1.529*** (2.905)	0.462 (1.171)	0.888** (2.386)	0.547 (0.911)
tobin	0.011 (0.564)	-0.004 (-0.298)	-0.005 (-0.399)	0.043* (1.749)
top5	-0.239 (-1.336)	-0.600** (-2.501)	-0.259 (-1.442)	-0.486** (-2.116)
debt	0.276 (1.120)	0.428* (1.679)	0.054 (0.241)	0.360 (1.275)
netprofit	-0.279 (-0.651)	0.464 (0.659)	0.025 (0.065)	-0.073 (-0.092)
_cons	1.159 (0.905)	-0.767 (-0.615)	0.414 (0.372)	-0.846 (-0.541)
id	Yes	Yes	Yes	Yes
time	Yes	Yes	Yes	Yes
N	4189	3474	4758	2905
R <sup>2</sup>	0.0102	0.0084	0.0054	0.0126

Note: Values in parentheses are values, \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels (two-tailed), respectively.

## 5 Conclusion

This study systematically analyzes the pathways of strategic heterogeneity and environmental information disclosure quality, based on panel data of A-share listed companies from Shanghai

and Shenzhen stock markets in 2012-2022, by establishing a bidirectional fixed-effects econometric model to empirically examine the transmission mechanism of strategic differences on corporate greenwashing behavior. The findings reveal that when a firm's strategic choices significantly deviate from industry conventional patterns, its symbolic characteristics in environmental information disclosure will systematically strengthen, and this association remains robust after controlling for municipalities, fixed industries, and one-period lagged variable tests. Heterogeneity tests indicate that the effect of strategic heterogeneity on greenwashing behavior is more pronounced in samples with high market competition, large scale, non-state-owned property structure, eastern and western geographical distribution, and manufacturing enterprises, suggesting that institutional constraint intensity and industry regulatory pressure jointly shape the environmental behavior choices of strategically differentiated firms. Notably, media attention shows that increased external attention amplifies the association between strategic heterogeneity and greenwashing behavior, with a significant positive moderating effect.

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