

Research on the Impact of Female Executive Proportion on Corporate Greenwashing

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Abstract: Greenwashing has become a major obstacle to the green transformation and sustainable development of enterprises. Based on the Upper Echelons Theory and Imprinting Theory, this study examines the relationship between the proportion of female executives and corporate greenwashing behavior using data from A-share listed companies on the Shanghai and Shenzhen stock exchanges between 2014 and 2023. The research finds that female executives significantly promote corporate greenwashing behaviors; the proportion of female executives in key positions (CEO/Chairman) and the proportion of highly educated female executives both significantly enhance the degree of corporate greenwashing. Further research finds that the impact of the proportion of female executives on corporate greenwashing is more pronounced in private enterprises and low-pollution industries. This study provides a new theoretical perspective and empirical evidence for governing corporate greenwashing.

Keywords: Female Executives; Greenwashing; Upper Echelons Theory; Imprinting Theory

1. Introduction

Against the backdrop of the "Dual Carbon" strategy and the construction of ecological civilization, the authenticity of corporate social responsibility (CSR) fulfillment and information disclosure has become the focus of social attention. However, many enterprises adopt greenwashing strategies, which refer to the behavior where enterprises conduct more symbolic communication on environmental issues than substantive actions in order to obtain legitimate interests. In plain terms, greenwashing means "saying more than doing" ^[1]. Such behavior not only damages the rights and interests of stakeholders such as investors and consumers, but also undermines the efficiency of market resource allocation, ultimately hindering

the green transformation of the economy.

Meanwhile, research in the field of corporate governance has increasingly focused on the impact of the characteristics of the top management team on corporate strategic decision-making. Among them, gender diversity of executives, especially the participation of female executives, is generally considered to improve corporate governance and strategic decision-making. In recent years, the presence of women on the boards of Chinese listed companies has shown a steady growth trend, and by 2023, the proportion of women has increased to 15.7%. Existing studies have shown that female executives are usually more risk-averse, pay more attention to the interests of stakeholders, and have stronger empathy and long-term orientation. Theoretically, these traits should make them more inclined to oppose short-sighted and ethically risky greenwashing behaviors.

Existing literatures mainly focus on the motivations of greenwashing, which are mainly manifested in three aspects: economic interest motivation, institutional pressure motivation and internal organizational motivation.

Firstly, the economic interest theory posits that profit maximization is the core objective of enterprises, and their behaviors and decisions are mainly driven by economic interests. Research indicates that certain firms engage in greenwashing to comply with China's green credit standards, green bonds, government subsidies and other policies, and to obtain lower financing costs, some enterprises engage in greenwashing^[2]. Other studies point out that some enterprises attempt to obtain economic benefits brought by environmental protection at the lowest cost through symbolic environmental protection actions and greenwashing (i.e., claiming environmental commitments inconsistent with environmental performance), rather than through the improvement of substantive environmental performance ^[3].

Secondly, the institutional pressure theory

argues that when enterprises face the threat of "audits" from activists or non-governmental organizations (NGOs), enterprises with poor environmental performance have a stronger motivation to engage in greenwashing to pre-empt potential external criticism and regulatory pressure^[4]. In regions with strict environmental regulation and active environmental protection organizations, enterprises are more likely to conduct selective disclosure (i.e., greenwashing)^[5].

Thirdly, the internal organizational theory suggests that managerial short-termism will drive enterprises to adopt short-term opportunistic behaviors such as greenwashing, and the operational pressure brought by the performance expectation gap will further induce corporate greenwashing by exacerbating managerial short-termism^[6].

As the core subject of corporate strategic decision-making, executives' individual characteristics systematically affect corporate operational behaviors. Numerous studies demonstrate that female executives exhibit systematic differences from male executives in the decision-making process. These differences are mainly reflected in three dimensions: risk aversion tendency, higher moral standards and social responsibility, and long-term orientation.

In terms of risk aversion tendency, the risk-averse trait of female executives makes them more sensitive to the potential risks of financial fraud and take the initiative to avoid such behaviors^[7]. Companies led by female CEOs have lower risk-taking levels and higher capital allocation efficiency than those led by male CEOs^[8].

In terms of moral standards and social responsibility, Du Xingqiang et al.^[9] found that female executives uphold higher ethical and moral standards, and their inherent moral constraints make them pay more attention to regulating corporate operational decisions, becoming an important driver to inhibit improper corporate behaviors such as earnings management. Lu Jun^[10] also pointed out that female executives have a lower tolerance for opportunistic behaviors, and their higher moral standards make them more inclined to avoid corporate violations that damage the rights and interests of stakeholders in decision-making. At the practical level of social responsibility, Huang Heshu et al.^[11] confirmed that female executives demonstrate a stronger moral consciousness, and

this trait will drive them to actively improve the quality and level of corporate social responsibility information disclosure, and more actively fulfill the corporate social responsibility to stakeholders.

In terms of long-term orientation, as opposed to the short-term performance focus of male executives, female leaders exhibit stronger commitment to sustainable corporate development, evidenced by their efforts to advance enduring strategic initiatives such as digital transformation through alleviating managerial myopia^[12].

To sum up, the current empirical research directly targeting female executives and greenwashing is still insufficient, especially in the Chinese context. Based on this, this paper takes A-share enterprises on the Shanghai and Shenzhen Stock Exchanges from 2014 to 2023 as the research object to explore the impact of female executives on corporate greenwashing behaviors from both theoretical and empirical perspectives. This paper makes several novel contributions: To begin with, it pushes the frontiers of Upper Echelons Theory by linking the gender characteristics of executives with specific corporate greenwashing behaviors, enriching the research of this theory in the field of environmental ethics. Second, it enhances theoretical understanding of what drives greenwashing practices, offering a novel governance-based explanation for why firms vary in their greenwashing propensities by examining executive characteristics at the micro level. Third, it offers actionable guidance for firms seeking to refine their senior leadership composition, introduce talents with gender diversity and professional environmental protection background, guide enterprises to shift from "superficial greenwashing" to "genuine green development", accumulate green technologies and resources, help enterprises establish a real sustainable competitive advantage, and avoid the reputational and legal risks brought by greenwashing.

2. Conceptual Foundations and Proposition Formulation

2.1 The Impact of Female Executives on Corporate Greenwashing

The Upper Echelons Theory emphasizes that the demographic characteristics of the top management team affect corporate strategic

choices and behavioral decisions by influencing their cognitive models, value orientations and risk preferences^[13]. As an important part of the top management team, the behavioral characteristics and decision-making tendencies of female executives brought by their gender will materially affect corporate environmental governance behaviors.

The decision-making traits of female executives, such as risk aversion tendency, high moral standards and long-term orientation, are consistent with the decision-making logic of corporate greenwashing behaviors, driving them to have a positive impact on corporate greenwashing behaviors. Combining the Chinese institutional environment and the internal logic of the Upper Echelons Theory, it can be found that the behavioral characteristics of female executives may also push enterprises to adopt symbolic environmental behaviors, thus exacerbating greenwashing. From the perspective of risk aversion, Liu Jinke et al.^[14] found that compared with substantive green transformation, greenwashing, as a low-cost and low-risk symbolic environmental behavior, does not require a lot of R&D investment and resource integration, which is more in line with the low-risk decision-making preference of female executives. From the perspective of behavior selection logic, although female executives pay attention to the fulfillment of social responsibility, in the case of imperfect formal systems or lack of supervision mechanisms, greenwashing behaviors can help enterprises maintain a "green image" with low investment, balancing the shaping of social image and the control of corporate operational costs^[15]. From the perspective of obtaining external corporate legitimacy, the socially oriented trait of female executives makes them pay more attention to the external image of enterprises, and greenwashing behaviors can help enterprises quickly respond to environmental regulations and social expectations, obtain institutional legitimacy and social recognition, which is consistent with the decision-making tendency of female executives in corporate external image management^[16]. Therefore, this paper proposes Hypothesis 1 (H1):

H1: Female executives will promote corporate greenwashing behaviors.

2.2 Female Executives and Corporate

Greenwashing: The Moderating Effect of Women in Key Positions (CEO/Chairman)

As the core decision-makers of enterprises, CEOs and Chairmen hold the supreme right to speak in corporate strategy formulation and resource allocation, and their personal traits have a far greater impact on corporate behaviors than ordinary executives^[17]. When female executives serve as CEOs or Chairmen, their decision-making traits can be more directly transformed into actual corporate behaviors, breaking the right of speech restrictions of ordinary female executives in decision-making, and thus strengthening the promotional effect of female executives on corporate greenwashing behaviors. The decision-making suggestions of ordinary female executives are easily influenced by male executive-dominated teams, while female CEOs or Chairmen can directly integrate the decision-making preferences of low risk and heavy image into the formulation of corporate environmental strategies by virtue of core decision-making power, promoting enterprises to choose low-cost green image shaping methods such as greenwashing^[18]. At the same time, the power intensity of female executives positively moderates their impact on corporate strategy. Female executives serving as CEOs/Chairmen have higher power intensity, and their driving effect on corporate greenwashing behaviors can be more fully exerted^[12]. Therefore, this paper proposes Hypothesis 2 (H2):

H2: Women holding key positions (CEO or Chairman) will strengthen the positive relationship between the proportion of female executives and the degree of corporate greenwashing.

2.3 Female Executives and Corporate Greenwashing: The Moderating Effect of Highly Educated Female Executives

The Imprinting Theory points out that the knowledge, skills and cognitive traits formed by individuals in key development stages will form an "imprint" and continuously affect their subsequent behavioral decisions^[19]. The professional knowledge imprint and cognitive ability imprint formed by highly educated female executives in the education stage endow them with stronger information processing, image management and institutional interpretation capabilities, enabling them to more accurately grasp the requirements of environmental regulations and the preferences of

the capital market, and thus more effectively promote enterprises to achieve image shaping and legitimacy acquisition through greenwashing behaviors. On the one hand, the professional knowledge imprint brought by high education makes female executives more aware of the rules and boundaries of environmental information disclosure, and can implement greenwashing behaviors through more refined selective disclosure and expressive manipulation, improving the effect and concealment of greenwashing^[20]. On the other hand, the cognitive ability imprint formed by high education enables them to more acutely perceive external institutional pressure and market expectations, timely respond to external requirements through greenwashing behaviors, and at the same time, rely on stronger decision-making capabilities to promote the implementation of greenwashing behaviors within enterprises^[21]. These traits of highly educated female executives make their driving effect on corporate greenwashing behaviors more significant, thereby strengthening the positive relationship between female executives and corporate greenwashing. Therefore, this paper proposes Hypothesis 3 (H3):

H3: The presence of highly educated female executives will strengthen the positive relationship between the proportion of female executives and the degree of corporate greenwashing.

3. Research Design

3.1 Data Sources

This study selects data of A-share listed companies on the Shanghai and Shenzhen Stock Exchanges from 2014 to 2023, which are mainly sourced from the CSMAR database. The data are processed as follows: excluding listed companies in the real estate and financial industries, as well as companies with special treatments such as ST and *ST; excluding observations with missing data of key variables. A total of 2377 observations are finally obtained. To mitigate the influence of outliers and enhance robustness, continuous variables undergo winsorization at the 1st and 99th percentiles.

3.2 Variable Selection

3.2.1 Dependent variable

The degree of corporate greenwashing (GWL). There are two existing measurement methods for

greenwashing: one is to use content analysis to manually evaluate disclosure items. For example, Huang Rongbing et al. manually evaluate whether the environmental sections of annual reports, sustainable development reports, social responsibility reports and environmental reports publicly disclosed by listed companies every year are symbolic disclosure or substantive disclosure, and then calculate the degree of corporate greenwashing. The other is to use the ratings of third-party rating agencies to conduct a comprehensive and objective evaluation of enterprises. Because the first method is manual evaluation with strong subjectivity, this paper adopts the second measurement method. Referring to the research of Zhang^[22], Formula (1) is constructed:

$$GWL = \left(\frac{ESG_{dis\ i,t} - \overline{ESG}_{dis}}{\sigma_{dis}} \right) - \left(\frac{ESG_{per\ i,t} - \overline{ESG}_{per}}{\sigma_{per}} \right) \quad (1)$$

The right-hand side comprises two standardized metrics: the first gauging the firm's relative placement among peers in ESG disclosure score distribution, and the second gauging its relative placement among peers in ESG performance score distribution. Specifically, The variable $\overline{ESG}_{dis}$ captures the mean enterprise disclosure score, $\overline{ESG}_{per}$ captures the mean enterprise performance score, and σ_{dis} and σ_{per} stand for the standard deviations of disclosure scores and performance scores, respectively. This paper uses Bloomberg ESG ratings as disclosure scores and Huazheng ESG ratings as performance scores.

3.2.2 Independent variable

Female executives (Female_ratio), measured by the ratio of female executives in the senior management team to the total number of the top management team. At present, there are three main methods in academia to measure female executives: the number of female executives, the ratio of female executives to the total number of the top management team, and dummy variables. Considering the large differences in the size of the top management team of different enterprises, simply using the number is difficult to fairly compare the relative degree of female participation in governance in enterprises of different sizes, while the proportion indicator can strip off the interference of enterprise size and more accurately reflect the right of speech and influence of women in the top management team. Consequently, this study employs the percentage of female executives as a proxy for female executive representation.

3.2.3 Moderating variables

(1) The proportion of female executives in key positions: CEO or Chairman (Topf_ratio). CEOs and Chairmen are the commanding heights of core decision-making and power of enterprises, and their gender characteristics have a decisive impact on the strategic orientation of enterprises. Compared with ordinary female executives, female managers in key positions have higher decision-making power and resource allocation power, and can more effectively break through the restrictions of governance levels and directly affect the strategic formulation and operational decisions of enterprises. Referring to the existing research on the division of executive power levels^[18], to capture women's penetration into the inner power circle, we construct a ratio of female CEOs or Chairmen to overall female executives, and subsequently examine how this ratio moderates the association between female executive representation and firm-level greenwashing activities.

(2) The proportion of highly educated female executives (Hef_ratio). Education is the core representation of executives' human capital level, and high education means stronger cognitive ability, professional quality and information processing ability. Existing studies have shown that highly educated female executives have a deeper understanding of environmental governance and social responsibility, and have higher willingness and execution capacity in promoting substantive green transformation. Referring to the existing research on the measurement of the heterogeneity of executives' human capital^[19], this paper selects the proportion of highly educated female executives to explore the impact of the heterogeneity of female executives' human capital on corporate greenwashing behaviors.

3.2.4 Grouping variables

(1) Based on property right nature (State)

The nature of property rights significantly affects the governance logic and environmental behavior constraints of enterprises: relative to private firms, state-owned entities operate under intensified regulatory scrutiny and elevated societal accountability expectations, while non-state-owned enterprises concentrate

predominantly on operational efficiency and market competitiveness.^[23] The institutional differences between the two will make the governance effect of female executives on greenwashing behaviors heterogeneous. Referring to the existing research on the group test method of corporate property right nature^[24], this paper takes the nature of property rights as a grouping variable to test the heterogeneity of the impact of female executives on corporate greenwashing behaviors under different property right backgrounds.

(2) Based on the degree of industrial pollution (HighPollu)

The degree of industrial pollution determines the environmental regulatory pressure and greenwashing motivation faced by enterprises. Heavily polluting industries are subject to stringent environmental constraints and become key regulatory targets in environmental governance, resulting in higher costs and risks associated with greenwashing behaviors^[25]. In contrast, lightly polluting industries face weaker environmental constraints, where the governance effect of female executives may be less pronounced. Following the classification criteria for industry-level environmental characteristics established in previous literature^[14], this paper conducts subsample tests based on industrial pollution intensity to examine the heterogeneous effects of industry characteristics on corporate greenwashing.

3.2.5 Control variables

Referring to the research of Huang Rongbing et al.^[20] and combining the classic selection ideas of control variables for corporate governance and enterprise characteristics, the control variables selected in this paper include firm size (Size), solvency (Lev), profitability (ROE), development capacity (Growth), board size (Board), proportion of independent directors (IB), ownership concentration (Shrcrl), ownership balance degree (Balance2_5), and CEO duality (Dual). In the subsequent analysis, the nature of property rights (State) and the degree of industrial pollution (HighPollu) are added as heterogeneity analysis tests. The specific variable definitions are shown in Table 1.

Table 1. Variable Definitions

Variable Type	Variable Name	Variable Symbol	Variable Definition
Dependent Variable	Degree of Greenwashing	GWL	Determined in accordance with Formula(1)
Independent	Proportion of Female	Female ratio	Female composition of the executive team

Variable	Executives		
Control Variable	Firm Size	Size	Total assets at period conclusion, log-transformed with a constant of one
	Solvency	Lev	Total liabilities / Total assets
	Profitability	ROE	Earnings-to-equity ratio, with equity averaged over the period
	Development Capacity	Growth	Operating revenue growth rate, calculated as the first difference scaled by lagged operating income
	Board Size	Board	Natural logarithm of the number of board members plus 1
	Proportion of Independent Directors	IB	Board independence ratio, measured as independent directors divided by total directors
	Ownership Concentration	Shrcrl	Shareholding ratio of the largest shareholder
	CEO Duality	Dual	Binary variable capturing CEO-Chairman duality (1 = combined roles, 0 = separate roles)
	Ownership Balance Degree	Balance2_5	Shareholding ratio of the 2nd to 5th largest shareholders / Shareholding ratio of the largest shareholder
Moderating Variable	Proportion of Highly Educated Female Executives	Hef_ratio	Proportion of highly educated female executives to the total number of female executives (Master's degree and above as high education)
	Proportion of Female Executives in Key Positions	Topf_ratio	Proportion of female executives serving as CEO or Chairman to the total number of female executives
Grouping Variable	Property Right Nature	State	Dummy variable capturing ownership identity (1 = state ownership, 0 = non-state ownership)
	Degree of Industrial Pollution	HighPollu	Pollution intensity dummy (1 = high-pollution sector membership, 0 = low-pollution sector membership)

3.3 Model Setting

To test the relationship between female executives and corporate greenwashing behaviors, this paper constructs Model (2):

$$GWL_{i,t} = \alpha_0 + \alpha_1 \text{Female_ratio}_{i,t} + \alpha_2 \text{Controls}_{i,t} + \sum \text{Firm} + \sum \text{year} + \varepsilon_{i,t} \quad (2)$$

Among them, i represents the individual, t represents the year, GWL represents the degree of corporate greenwashing, the variable Female_ratio measures women's representation in executive leadership, Controls encompasses the battery of control variables, Firm and Year indicate unobserved heterogeneity at the firm and year levels, respectively, and ε captures the idiosyncratic disturbance.

To test the moderating effect of the proportion of highly educated female executives to the total number of female executives on the relationship between corporate greenwashing behaviors, this paper constructs Model (3):

$$GWL_{i,t} = \beta_0 + \beta_1 \text{Female_ratio}_{i,t} + \beta_2 \text{Hef_ratio}_{i,t} + \beta_3 \text{Female_ratio}_{i,t} \times \text{Hef_ratio}_{i,t} + \beta_4 \text{Controls}_{i,t} + \sum \text{Firm} + \sum \text{year} + \varepsilon_{i,t} \quad (3)$$

Among them, Hef_ratio represents the

proportion of highly educated female executives to the total number of female executives (Master's degree and above as high education). The interaction term ($\text{Female_ratio} \times \text{Hef_ratio}$) is centralized to avoid the impact of multicollinearity.

To test the moderating effect of the proportion of female executives serving as CEO or Chairman to the total number of female executives on the relationship between corporate greenwashing behaviors, this paper constructs Model (4):

$$GWL_{i,t} = \gamma_0 + \gamma_1 \text{Female_ratio}_{i,t} + \gamma_2 \text{Topf_ratio}_{i,t} + \gamma_3 \text{Female_ratio}_{i,t} \times \text{Topf_ratio}_{i,t} + \gamma_4 \text{Controls}_{i,t} + \sum \text{Firm} + \sum \text{year} + \varepsilon_{i,t} \quad (4)$$

Among them, Topf_ratio represents the proportion of female executives serving as CEO or Chairman to the total number of female executives. The interaction term ($\text{Female_ratio} \times \text{Topf_ratio}$) is centralized to avoid the impact of multicollinearity.

3.4 Descriptive Summaries and Intercorrelation Examination

The distributional characteristics of main variables are documented in Table 2. The

number of observations for corporate greenwashing (GWL) is 2377, with a mean value of 0.000, a standard deviation of 1.165, a minimum value of -4.030 and a maximum value of 4.675, which indicates that there are large differences in the degree of greenwashing among sample enterprises, and some enterprises have obvious greenwashing behaviors. Descriptive statistics for Female_ratio indicate a mean of 0.209, standard deviation of 0.099, and bounds of [0.028, 0.500], implying that while female executives constitute a minority in most firms, their prevalence varies considerably across the sample. In terms of moderating variables, the mean value of the proportion of highly educated female executives (Hef_ratio) is 0.548, with a standard deviation of 0.310, a

minimum value of 0 and a maximum value of 1, indicating that the proportion of female executives with postgraduate degrees and above is generally high in the female executive group, but the differences among enterprises are significant; the mean value of the proportion of women in key positions (Topf_ratio) is 0.043, with a standard deviation of 0.111, indicating that women serving as CEOs or Chairmen and other key positions are not common in the sample. Descriptive statistics for covariates reveal mean values of 23.420 for Size, 0.472 for Lev, 0.090 for ROE, 0.153 for Growth, 37.190 for IB, 36.720 for Shrcrl, 0.214 for Dual, and 0.678 for Balance2_5., all of which are in a reasonable range and consistent with the overall characteristics of China's listed companies.

Table 2. Descriptive Statistical Results

Variable	Observations	Mean	Std. Dev.	Min	50% Quantile	75% Quantile	Max
GWL	2377	0.000	1.165	-4.030	-0.014	0.791	4.675
Female_ratio	2377	0.209	0.099	0.028	0.200	0.267	0.500
Size	2377	23.420	1.207	20.960	23.320	24.210	26.190
Lev	2377	0.472	0.185	0.072	0.478	0.619	0.857
ROE	2377	0.090	0.108	-0.399	0.091	0.142	0.354
Growth	2377	0.153	0.314	-0.481	0.103	0.245	1.667
Board	2377	2.293	0.175	1.792	2.303	2.303	2.708
IB	2377	37.190	5.181	33.330	35.710	40.000	57.140
Shrcrl	2377	36.720	15.310	9.240	35.330	48.010	74.090
Dual	2377	0.214	0.410	0.000	0.000	0.000	1.000
Balance2_5	2377	0.678	0.553	0.036	0.508	1.000	2.373
Hef_ratio	2377	0.548	0.310	0.000	0.500	0.750	1.000
Topf_ratio	2377	0.043	0.111	0.000	0.000	0.000	1.000

Bivariate correlations are investigated via Pearson correlation analysis. The results show that the correlation coefficient between the proportion of female executives (Female_ratio) and corporate greenwashing (GWL) is 0.048, which is significantly positive at the 5% level, initially indicating that the higher the proportion of female executives, the higher the degree of corporate greenwashing, providing preliminary support for the core hypothesis of this paper. In addition, there are correlations of varying degrees between each control variable and the core variables, Notwithstanding, with all correlation coefficients bounded by |0.7|, the data do not exhibit problematic multicollinearity. For further verification, this paper calculates the variance inflation factor (VIF), and all variables exhibit VIF values between 1.010 and 2.180 (mean = 1.420), comfortably below the problematic threshold of 10., which reconfirms that there is no serious multicollinearity between

variables, laying a good foundation for the subsequent regression analysis.

4. Empirical Results and Analysis

4.1 Multiple Linear Regression Analysis

4.1.1 Regression Results of Corporate Greenwashing and Female Executives

To enhance the reliability of core conclusions, this study replicates the regression analysis of Model (1) with heteroscedasticity-robust standard errors. Table 3 shows the regression results of the pooled effect, fixed effect and random effect models. It can be seen from Column (2) of Table 3 that the regression coefficient of the proportion of female executives (Female_ratio) on corporate greenwashing (GWL) is 1.468, which is significantly positive at the 1% level. In economic terms, each percentage point increment in the female executive ratio is

associated with a 1.468-unit elevation in greenwashing levels, substantiating the core hypothesis (H1) regarding the significant facilitative effect of female executives on such deceptive environmental practices. The reason is that under the current institutional background, female executives are more inclined to adopt symbolic environmental behaviors in order to quickly establish a green image, meet external supervision and stakeholder expectations, and avoid the costs and operational risks brought by substantive environmental protection investment. Compared with male executives, female executives have stronger motives for impression management and reputational constraints, so they are more likely to respond to external pressure through greenwashing strategies, which ultimately manifests as a promotional effect on corporate greenwashing.

Table 3. Baseline Regression Results

	(1)	(2)	(3)
	GWL	GWL	GWL
Female_ratio	0.865*** (0.244)	1.468*** (0.417)	1.265*** (0.308)
cons	-4.684*** (0.616)	-16.165*** (1.448)	-8.996*** (0.849)
N	2377.000	2377.000	2377.000
R ²	0.070	0.128	
Adj-R ²	0.065	-0.150	

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1.2 The moderating effect of the proportion of female executives in key positions (ceo/chairman) and highly educated female executives

Column (1) of Table 4 reports how the proportion of highly educated female executives (Hef_ratio) conditions the association between female executive representation (Female_ratio) and corporate greenwashing (GWL). The coefficient on the interaction term (Hef_ratio $\times$ Female_ratio) is statistically positive at conventional levels ($p < 0.05$), suggesting that the facilitating effect of female executive presence on corporate greenwashing intensifies as the share of highly educated female executives rises, thereby corroborating Hypothesis H3. This is because education is the core representation of executives' human capital, and highly educated female executives have stronger information integration capabilities and professional research and judgment levels, and are more sensitive to the strategic choice of

environmental information disclosure. When the proportion of highly educated female executives increases, the female executive group is more likely to choose low-cost and high-promotional symbolic environmental disclosure methods such as greenwashing through professional judgment to send green signals to the market, thus amplifying the promotional effect of the proportion of female executives on corporate greenwashing behaviors.

Column (2) of Table 4 reports how the share of female executives in key leadership roles (CEO or Chairman) conditions the association between overall female executive presence and corporate greenwashing. The coefficient on the interaction term (KeyFemale_ratio $\times$ Female_ratio) is statistically positive ($p < 0.05$), indicating that the facilitating effect of female executive representation on corporate greenwashing intensifies as more women assume CEO or Chairman positions, thereby corroborating Hypothesis H2. This is because CEOs or Chairmen, as the core roles of corporate strategic decision-making, hold the ultimate power of information disclosure and strategic publicity. As women's penetration into core leadership intensifies, they exhibit a heightened tendency to instrumentalize greenwashing strategically: orchestrating environmental information disclosure to forge a green corporate image, secure organizational legitimacy, and garner market recognition, which materially strengthens the positive association between female executive representation and greenwashing activities.

Table 4. Regression Results of Moderating Effects

	(1)	(2)
	GWL	GWL
Female_ratio	1.544*** (0.414)	1.548*** (0.414)
Hef_ratio	0.261** (0.127)	
Female_ratio* Hef_ratio	2.223** (1.010)	
Topf_ratio		-0.134 (0.259)
Female_ratio*Topf_ratio		4.830** (2.290)
cons	-16.084*** (1.448)	-16.354*** (1.448)
N	2377	2377
R ²	0.128	0.128

Adj-R ²	-0.149	-0.150
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Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Heterogeneous Treatment Effects

4.2.1 Based on different property right natures

The character of property rights serves as a critical institutional force influencing firms' strategic calculus and conduct. Enterprises with different property right attributes have significant differences in governance objectives, regulatory constraints and behavioral preferences. State-owned enterprises undertake a stronger mission of policy compliance and social responsibility, and their environmental behaviors are more likely to be constrained by government supervision and public supervision; while non-state-owned enterprises pay more attention to market performance and legitimacy acquisition, and their behavioral strategies are more flexible. Accordingly, the influence of female executive presence on corporate greenwashing behavior is likely to vary across different property rights regimes. The estimation results are reported in Columns (1) and (2) of Table 5. Within the non-state-owned enterprise subsample, the female executive ratio exhibits a statistically positive coefficient at conventional significance levels ($p < 0.01$), suggesting that elevated female executive representation significantly exacerbates greenwashing behavior among privately controlled firms.

This is because the environmental behaviors of state-owned enterprises are subject to stricter administrative constraints and social supervision, and the space for symbolic strategies such as greenwashing is compressed; while non-state-owned enterprises face relatively weak constraints and are more inclined to shape a green image through greenwashing behaviors to obtain market recognition and financing advantages, so the promotional effect of the increase in the proportion of female executives on greenwashing behaviors is more prominent in non-state-owned enterprises.

4.2.2 Based on different degrees of industrial pollution

The degree of industrial pollution determines the intensity of environmental regulatory pressure and public attention faced by enterprises. High-pollution industries are key areas of environmental governance, and their environmental behaviors are subject to stricter supervision and constraints; while low-pollution

industries face relatively small environmental regulatory pressure, and enterprises are more likely to send green signals through symbolic environmental disclosure. Accordingly, the influence of female executive presence on corporate greenwashing behavior is likely to vary across different levels of industrial pollution. The empirical findings are presented in Columns (3) and (4) of Table 5. In the sample of low-pollution industries, the regression coefficient of the proportion of female executives is significantly positive at the 1% level, indicating that the increase in the proportion of female executives will significantly promote the greenwashing behaviors of enterprises in low-pollution industries.

This is because high-pollution industries face higher intensity of environmental regulation, and the costs and risks of greenwashing behaviors are significantly increased, so enterprises are more inclined to adopt substantive environmental protection practices; while low-pollution industries face less regulatory pressure, and enterprises are more likely to shape a green image through low-cost strategies such as greenwashing, so the facilitative impact of elevated female executive presence on greenwashing behavior exhibits greater salience in environmentally benign industries.

Table 5. Results of Heterogeneity Analysis

	(1)	(2)	(3)	(4)
	State=0	State=1	HighPollu=0	HighPollu=1
Female ratio	1.470***	1.035	2.174***	0.189
	(0.555)	(0.639)	(0.474)	(0.798)
cons	-10.439***	-25.905***	-16.112***	-17.538***
	(1.894)	(2.492)	(1.693)	(2.732)
N	1132	1245	1512	865
R ²	0.117	0.16	0.144	0.138
Adj-R ²	-0.180	-0.120	-0.140	-0.130

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3 Endogeneity Treatment

To alleviate the potential endogeneity problem, this paper adopts two methods: lagged variable method and instrumental variable method for testing.

4.3.1 Lagged variable method

To alleviate the potential endogeneity problem, especially the bias caused by current reverse causality, we lag the proportion of female

executives variable by one period and re-regress. Regression estimates reveal that the one-period lagged proportion of female executives exhibits a statistically positive coefficient at conventional levels ($p < 0.10$), aligning with the principal conclusions. These findings demonstrate that the positive association between female executive proportion and corporate greenwashing remains robust when temporal sequencing is incorporated and contemporaneous endogeneity is alleviated.

Table 6. One-period Lagged Variables

	(1)	(2)
	Female ratio	GWL
L.Female ratio	0.480*** (0.025)	0.967* (0.526)
cons	0.113*** (0.005)	-11.941*** (2.025)
N	1615.000	1615.000
R ²	0.237	0.073
Adj-R ²	-0.049	-0.284

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3.2 Two-stage least squares methodology

To mitigate endogeneity concerns arising from unobserved confounders, this study employs instrumental variable estimation via two-stage least squares. The selected instrument, *iv_Female_ratio*, captures the average female executive proportion among industry-year peers. First-stage regression (Table 7, Column 1) documents a statistically positive coefficient at the 1% level alongside an F-statistic of 18.878—well above the conventional threshold of 10—alleviating weak instrument concerns. The second-stage estimates (Column 2) reveal that female executive presence retains its significantly positive effect at the 1% level, consistent with baseline results. These findings affirm that the positive association between female executives and greenwashing persists after accounting for endogeneity, underscoring the reliability of our core conclusions.

Table 7. Instrumental Variable (2SLS)

Regression Results

	(1)	(2)
	Female ratio	GWL
iv_Female_ratio	0.458*** (0.038)	
Female_ratio		10.594*** (1.727)
cons	0.158** (0.080)	-16.817*** (1.631)
N	2377.000	2377.000

R ²	0.095	
Adj-R ²	-0.192	
F	18.878	

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.4 Specification Robustness

To further verify the robustness of the core conclusions, this paper conducts analysis by two methods: model specification test and lagged variable method.

4.4.1 Model specification

After preprocessing the data via 1% and 99% winsorization to attenuate extreme value distortion, this study employs pooled regression, entity fixed effects, and random effects estimators sequentially. As documented in Table 3, the coefficient on female executive proportion is statistically positive at the 1% threshold under each specification, demonstrating that the conclusion regarding female executives' facilitative effect on greenwashing is insensitive to model choice and exhibits considerable stability.

4.4.2 Lagged variable

To further corroborate the stability of our findings, we temporally displace the three key variables—female executive representation, highly educated female executive share, and female executives in key positions—by two periods and re-estimate the models. As reported in Table 8, the two-period lagged female executive ratio retains a statistically positive coefficient at the 5% level, and the interaction between female executive presence and highly educated female executive proportion remains positive and significant at the 5% threshold, mirroring the baseline regression conclusions. The insignificance of some interaction term coefficients is mainly due to the weak moderating effect itself or high sensitivity to the lag structure, which does not affect the robustness of the core conclusions. On the whole, under a variety of robustness test methods, the core conclusions of this paper have not changed substantially, indicating that the research results have strong reliability and robustness.

Table 8. Two-Period Lagged Variables

	(1)	(2)
	GWL	GWL
Female_ratio	0.584 (0.608)	1.060* (0.639)
Female_ratio*Hef_ratio	1.666	-0.454

	(1.422)	(1.515)
Female_ratio*Topf_ratio	5.007	4.108
	(3.606)	(4.048)
L.Female_ratio	0.770	
	(0.601)	
L2.Female_ratio		1.498**
		(0.621)
L.Female_ratio*Hef_ratio	1.797	
	(1.430)	
L2.Female_ratio*Hef_ratio		4.018**
		(1.571)
L.Female_ratio*Topf_ratio	-2.117	
	(3.097)	
L2.Female_ratio*Topf_ratio		-4.301
		(2.865)
cons	-12.058***	-17.760***
	(2.030)	(2.705)
N	1615.000	1275.000
R ²	0.079	0.117
Adj-R ²	-0.280	-0.248

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5. Concluding Remarks

Grounded in Upper Echelons Theory and Imprinting Theory, this paper investigates how the proportion of female executives relates to corporate greenwashing behavior, employing data from Shanghai and Shenzhen A-share listed companies spanning 2014 through 2023. The findings reveal that the proportion of female executives is significantly and positively correlated with the degree of corporate greenwashing. Driven by risk aversion tendencies and image management motives, female executives are more inclined to opt for low-cost symbolic environmental behaviors, thereby facilitating corporate greenwashing. Both the proportion of female executives in key positions (CEO/Chairman) and the proportion of highly educated female executives reinforce the aforementioned positive relationship: the endorsement of core decision-making power makes it easier for the decision-making preferences of female executives to be translated into corporate behaviors, while the professional and cognitive imprints formed by high education enable female executives to implement greenwashing strategies more accurately and efficiently. The promotional effect of the proportion of female executives on corporate greenwashing is heterogeneous, being more pronounced in private enterprises and

low-pollution industries, where such enterprises face weaker environmental supervision and institutional constraints, providing greater room for the practice of greenwashing behaviors.

In light of these findings, the following policy implications are proposed: (1) For regulatory authorities: First, it is necessary to improve the regulatory system for corporate environmental information disclosure, strengthen the verification of the authenticity of environmental information disclosure, and break the path of symbolic environmental behaviors where enterprises "emphasize disclosure over practice". In particular, supervision over environmental information of private enterprises and those in low-pollution industries should be tightened to narrow the space for greenwashing in such enterprises. Second, establish substantive assessment criteria for environmental information disclosure, incorporate actual performance such as environmental protection investment and green technology R&D into the assessment system, and force enterprises to shift from "superficial greenwashing" to substantive green transformation. (2) For enterprises: A nuanced assessment of how gender heterogeneity in the upper echelons affects corporate governance is warranted. Achieving green development does not merely rely on increasing the proportion of female executives; more attention should be paid to cultivating the professional structure and value orientation of the top management team. While recruiting female executives, enterprises should establish internal incentive and restraint mechanisms for green development to guide executives to translate environmental responsibilities into substantive environmental protection actions rather than symbolic image management. Meanwhile, for female executives holding key positions, a supervision mechanism for environmental decision-making should be established to prevent them from using decision-making power to engage in greenwashing behaviors. (3) For the capital market: Investors should be guided to rationally identify corporate green information, abandon the judgment standard of "emphasizing disclosure form over actual performance", and focus on substantive environmental performance indicators such as corporate environmental protection investment and green production capacity upgrading. The market pricing mechanism should be leveraged to curb

corporate motives for greenwashing, enabling enterprises that truly practice green development to gain recognition from the capital market.

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