The Influence of the Audit Committee's Environmental Expertise on Corporate Greenwashing Practices

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Abstract: This study examines the influence of an audit committee's environmental background on corporate greenwashing behavior, using a sample of Chinese A-share listed firms from 2010 to 2022. The empirical findings suggest that firms with audit committees possessing environmental expertise demonstrate significantly lower instances of "greenwashing". Mechanism analyses indicate that this effect is achieved by mitigating managerial short-termism, reducing green agency costs, and fostering green innovation. Further heterogeneity analyses reveal that the suppressing effect of an audit committee's environmental background on greenwashing is more pronounced in private firms, when the audit committee has higher reputational capital, when CEO power is relatively weak, when firms have more developed environmental governance systems, and in regions with higher levels of green finance development. Additional economic consequence tests show that by curbing greenwashing, audit committees with environmental backgrounds contribute to improved corporate green governance performance. This study provides novel theoretical and empirical evidence on the non-financial information governance role of audit committees, offering important implications for enhancing the credibility of environmental information disclosure and promoting sustainable corporate development.

Keywords: Audit Committee; Environmental Context; Greenwashing; Management Short-sightedness; Green Innovation

1. Introduction

With the growing global emphasis on sustainable investment and the establishment of China's "dual carbon" goals, environmental performance has become a critical factor for firms in gaining the trust and resources of key stakeholders, including governments, financial institutions, supply chain partners, and the general public (Wellalage et al.,2023;Zhang et al.,2025). Investors, such as shareholders and creditors, increasingly expect firms to provide comprehensive environmental information disclosures to support informed decision-making (Azuma & Higashida,2024). By disclosing environmental reports that signal favorable environmental performance to the market, firms can obtain government subsidies (Wellalage et al.,2023), gain improved access to credit resources (Hui et al.,2024), reduce financing costs (Dhaliwal et al.,2011), and enhance economic efficiency (Plumlee et al.,2015). However, these potential benefits also create strong incentives for firms to exploit information asymmetry and engage in "greenwashing" by strategically embellishing their environmental disclosures (Zhang,2022). Greenwashing refers to the selective disclosure of environmentally favorable information despite poor underlying environmental performance (Cho & Patten,2007;Delmas & Burbano,2011). Such practices distort information in capital markets, mislead investors, including shareholders and creditors (Al Shaer & Zaman,2018;Dwekat et al.,2020;Pozzoli et al.,2022), and may result in resource misallocation, efficiency losses, and the erosion of environmental trust, thereby hindering the development of high-quality capital markets. At the micro level, greenwashing undermines firm's sustainable competitive (Xu et al.,2025). At the meso level, it contributes to the formation of a "lemons market" and exacerbates adverse selection problems (Parguel et al.,2011). At the macro level, symbolic environmental compliance impedes the green transformation of the economy (Duan et al.,2026) and may ultimately lead to a decline in overall social welfare.

At present, environmental information disclosure among Chinese listed firms exhibits varying degrees of greenwashing, and curbing such practices has become a critical issue in the development of the capital market (Zhou et al.,2024). China's Supreme People's Court issued the Opinions on Fully, Accurately, and Comprehensively Implementing the New Development Philosophy to Provide Judicial Services for the Steady and Active Promotion of Carbon Peaking and Carbon Neutrality, which explicitly called for the legal adjudication of corporate environmental information disclosure disputes in order to effectively curb illegal practices such as greenwashing in the capital market. The existing literature generally suggests that strengthening regulatory intensity through environmental legislation (Seele & Gatti,2017), market-based environmental supervision (Wang et al.,2026), environmental vertical management reforms (Luo & Li,2026), and bank regulatory

penalties (Zhang,2023) can generate deterrent effects and effectively reduce corporate greenwashing. Some studies further argue that increasing information supply and alleviating corporate information asymmetry through market information intermediaries, such as media coverage, can help restrain greenwashing behavior (Ma et al.,2025). In addition, other research indicates that granting green certifications (Berrone et al.,2017;De Freitas Netto et al.,2020) and leveraging reputation-based mechanisms to promote resource-oriented environmental regulation can also mitigate corporate greenwashing. However, this stream of research largely overlooks the role of internal corporate governance mechanisms in constraining greenwashing behavior among listed firms.

The audit committee constitutes a core institution within modern corporate governance systems centered on the board of directors. Through its oversight of financial reporting, the audit committee plays a critical role in preventing controlling shareholders or management from misleading stakeholders through information manipulation (Alkebsee et al.,2022). However, empirical research on the governance role of audit committees in ensuring the quality of non-financial information, such as environmental disclosure, remains relatively limited (Amran et al.,2014). In practice, as regulatory frameworks and market participants increasingly expect audit committees to assume supervisory responsibilities over non-financial disclosures, their roles have expanded beyond traditional financial oversight to encompass environmental and social responsibility reporting (Trotman & Trotman,2015). Given the audit committee's central position in corporate governance, its effectiveness in supervising environmental information disclosure can be substantially enhanced when committee members possess the capability to verify and assess the credibility of environmental reports (Adam et al.,2024;Santonastaso et al.,2025). Nevertheless, many audit committee members currently lack familiarity with sustainability-related disclosure standards and possess limited expertise in environmental issues. As a result, there is an urgent need to strengthen audit committees' capacity to oversee environmental information disclosure. Appointing directors with environmental backgrounds to audit committees is widely regarded as an effective approach to improving the quality of environmental disclosure among listed firms. Despite this, existing studies have paid insufficient attention to the environmental information oversight function of audit committees with environmental expertise.

Accordingly, a systematic examination of whether and how the environmental background of audit committees influences corporate greenwashing behavior is of substantial importance for improving the governance framework of non-financial information disclosure among listed firms, enhancing the resource allocation function of capital markets, and promoting sustainable economic and environmental

development. This study uses A-share listed companies on China's Shanghai and Shenzhen stock exchanges from 2010 to 2022 as its research sample. By manually collecting information on the environmental backgrounds of audit committee members, the study empirically examines the impact of audit committees' environmental background on corporate greenwashing behavior, investigates the underlying mechanisms from the perspectives of managerial cognitive orientation and investment structure adjustment, and further explores heterogeneity in this effect across different ownership structures, audit committee reputations, levels of CEO power, environmental governance systems, and regional green finance development. Finally, the study assesses the economic consequences of audit committee environmental background in terms of firms' green governance performance.

This study contributes to the literature in three main ways. (1) it extends research on audit committee environmental background from an information disclosure perspective. While existing studies suggest that audit committee characteristics facilitate corporate green transformation through green innovation outcomes (Gong et al.,2025), this study shifts attention to the role of audit committee members' environmental background in shaping corporate greenwashing behavior in environmental information disclosure. By doing so, it explicitly incorporates the supervisory function of the audit committee and deepens the understanding of how environmental expertise contributes to corporate green transition. (2) This study expands the literature on greenwashing governance by adopting an internal governance perspective. Whereas prior research has primarily emphasized the role of external governance mechanisms—such as government regulation, information intermediaries, and certification bodies—this study examines whether audit committee members with environmental backgrounds can restrain corporate greenwashing through internal governance structures, thus broadening the scope of factors influencing greenwashing behavior. (3) The findings offer practical implications for strengthening China's audit committee system and improving the quality of environmental information disclosure among listed companies.

2. Literature Review

2.1 Greenwashing of enterprises

Greenwashing refers to speculative practices whereby firms disseminate environmentally misleading information to the market through sustainability reports and other communication channels, typically characterized by short-term profit orientation and deceptive behavior. Under China's "dual carbon" goals, corporate green development has become a central focus of regulatory attention. Once exposed, greenwashing poses risks comparable to those of financial fraud and can generate substantial losses for both firms and capital market investors (Xu et al.,2025). It erodes

consumers' green trust and brand value (Chen & Chang,2013;Kurpierz & Smith,2020), dampens investor confidence (Gatti et al.,2021), and increases firms' vulnerability to market and regulatory scrutiny (Walker & Wan,2012). Moreover, greenwashing not only undermines the development of firms' sustainable capabilities (Walker & Wan,2012) but also reduces the efficiency of green resource allocation in capital markets (Parguel et al.,2011), thereby severely harming the interests of genuinely environmentally responsible firms. Consequently, addressing greenwashing has become a critical challenge under the "dual carbon" policy framework.

From a governance perspective, greenwashing can be understood as a strategic decoupling between environmental information disclosure and actual environmental behavior. Existing studies primarily examine external governance approaches through two main channels: constraining disclosure manipulation and enhancing environmental performance. With respect to constraining disclosure manipulation, prior research shows that external governance mechanisms—including environmental legislation (Seele & Gatti,2017), environmental centralization reforms (Luo & Li,2026), media scrutiny (Ma et al.,2025), and third-party sustainability ratings(De Freitas Netto et al.,2020) —can reduce information asymmetry, increase the supply of environmental information, and improve public awareness of firms' environmental practices, thereby curbing greenwashing. With respect to enhancing environmental performance, market-based incentive mechanisms such as eco-labeling systems (Berrone et al.,2017), green factory certification programs (Hua & Yuan,2025), and green subsidies(Zhong et al.,2025) can encourage voluntary environmental investment and effectively suppress greenwashing behavior.

However, corporate efforts to reduce greenwashing through external governance largely represent passive, expost responses. When governance loopholes persist, firms may instead adopt more concealed forms of environmental disclosure. Moreover, due to transaction costs, fully effective external governance is often difficult to achieve. Consequently, addressing greenwashing ultimately requires strengthening executives' environmental awareness (Hao et al.,2024), and transforming environmental investment into voluntary and proactive corporate behavior. Recent studies have increasingly emphasized the importance of internal governance mechanisms in this context. Internal governance arrangements related to environmental management can function as institutional safeguards for corporate green initiatives, enabling the prevention of ex ante environmental risks and the effective restraint of greenwashing. For example, Kurpierz & Smith (2020) showed that internal audit systems contribute to the development of environmental awareness and reduce greenwashing tendencies, while Ma & Ahmad (2024) discovered that female board representation mitigates corporate greenwashing behavior.

2.2 Environmental Information Governance Effect of Audit Committee Directors' Background

The audit committee, as a specialized body within the board of directors, was established to institutionalize and empower independent directors in exercising their authority. This structure ensures both their independence and professional competence in overseeing internal and external audits, as well as financial reporting processes, thereby enhancing the quality of corporate financial information (AM,2016;Susanto,2024). In recent years, with the global rise of sustainable investment and the increasingly central role of audit committees in corporate governance, their functions have expanded beyond supervising financial information quality to encompass non-financial aspects such as environmental reporting, social responsibility reporting, and ESG reporting (Amran et al.,2014). This expansion aims to identify and mitigate financial risks arising from environmental hazards. For instance, in 2022, the U.S. Securities and Exchange Commission (SEC) released the Draft Standard for Climate Data Disclosure by Public Companies, authorizing audit committees to oversee corporate climate risks. In 2021, the European Commission's Corporate Sustainability Reporting Directive (CSRD) proposal strengthened audit committees' responsibilities in verifying sustainability reports, mandating that member states ensure all listed companies establish audit committees and assign them specific tasks related to sustainability report verification. Similarly, in 2025, China's Securities Regulatory Commission (CSRC) issued the Measures for the Disclosure of Information by Listed Companies, requiring audit committees to supervise directors and senior management in fulfilling their information disclosure obligations.

Previous studies have examined the role of audit committees in promoting corporate sustainability. Iatridis (2013) found that the establishment of audit committees and a higher proportion of independent directors in Malaysian listed companies positively influenced the quality of environmental information disclosure. Al Shaer & Zaman (2018) demonstrated that audit committees, alongside boards of directors and sustainability committees, also impact voluntary environmental disclosures. However, research on enhancing audit committees' environmental oversight functions remains limited. Existing studies generally suggest that improving audit committee members' professional competence is a key approach to strengthening committee functions (Karamanou & Vafeas,2005;Sultana,2015), yet the core impact of audit committees on corporate disclosure supervision has not been thoroughly explored. Accordingly, this paper focuses on investigating how audit committees' environmental background influences corporate greenwashing practices, aiming to supplement the existing literature on corporate greenwashing governance and the environmental information governance role of audit committees.

3. Theoretical analysis and hypothesis

The new institutionalism theory posits that corporate behavior is influenced not only by economic factors such as technology and efficiency, but also by the formal and informal institutional environments in which firms operate. In recent years, driven by goals such as the "dual carbon" targets, economic transformation, and high-quality development, Chinese enterprises have faced increasingly stringent environmental regulations. The 2014 revision of the Environmental Protection Law of the People's Republic of China by the Standing Committee of the National People's Congress strengthened supervision and penalties for corporate pollution, sharply increasing environmental risks for firms. This regulatory tightening has coincided with the rise of sustainable finance, including green credit and ESG investment funds, as well as the growth of green technology industries. Under the green orientation of institutional and market resources, green transformation has become a crucial mechanism for firms to gain environmental legitimacy and stakeholder trust, thereby establishing a green agency relationship between stakeholders and corporate managers. This relationship generates a strong institutional logical tension with traditional financial agency relationships (Greenwood et al.,2010), requiring corporate managers to coordinate and balance the pursuit of green and financial performance.

However, behavioral decision theory suggests that managers, constrained by economic incentives, exhibit short-sighted tendencies such as bounded rationality and optimism (Delmas & Burbano,2011), which influence decisions regarding greenwashing. As environmental costs substantially reduce short-term marginal profits while providing longer payback periods, managers often prioritize immediate financial growth over environmental governance investments. Under institutional pressure, environmental risks increasingly translate into financial risks. To mitigate regulatory costs, managers are compelled to communicate corporate environmental compliance to regulators and stakeholders. Signaling theory highlights the information asymmetry between stakeholders and firms (Connelly et al.,2011), making environmental reporting a key channel of communication. Environmental reports serve as a critical medium to demonstrate compliance with laws and regulations, integration into green economic development, and as an essential basis for market assessment of corporate environmental risks (Marquis et al.,2016). Nevertheless, managers who control the environmental reporting process create opportunities for firms with poor environmental performance to gain legitimacy through report embellishment, while also incentivizing concealment of information to obstruct environmental oversight (Karamanou & Vafeas,2005). Consequently, under the dual influences of managerial short-sightedness and opportunism, environmental agency problems gradually emerge. Managers tend to selectively collect and disclose environmental information that enhances the firm's

image, engaging in strategic environmental disclosure behaviors such as greenwashing to temporarily mitigate environmental risks and obtain improper benefits.

The governance of greenwashing has become a critical issue requiring urgent attention in the pursuit of high-quality economic development. To address this challenge, the Chinese government has introduced a series of regulatory measures. On one hand, it has established disclosure standards, including the Measures for the Administration of Enterprise Environmental Information Disclosure in Accordance with the Law and the Guidelines for Enterprise Sustainability Disclosure—Basic Guidelines (Trial), aimed at reducing managers' discretionary power in information disclosure. On the other hand, through revisions to environmental legislation, the implementation of central environmental inspections, reforms of environmental judicial courts, and enhanced regulatory mechanisms such as "double random, one open" inspections, the government has continuously increased regulatory investment and intensified penalties for non-compliant disclosures, creating a deterrent effect against greenwashing practices (Ma et al.,2025;Seele & Gatti,2017). Meanwhile, market participants—including auditors, banks, and institutional investors—have also taken steps to identify and address greenwashing (Deng et al.,2024). However, due to information asymmetry and transaction costs, relying solely on administrative mandates and market incentives often fails to sustainably improve the quality of environmental disclosures. In some cases, it may even prompt managers to cater to regulatory requirements and market preferences, resulting in more covert forms of greenwashing. Therefore, enhancing corporate governance through preemptive oversight of environmental disclosure practices and incentivizing managers to adopt long-term perspectives in addressing greenwashing has become increasingly crucial (Hao et al.,2024).

The audit committee, as a dedicated financial oversight body within the board of directors, operates through a team of independent directors to intervene in management's information disclosure processes. By leveraging their independence and expertise, audit committees balance managerial information power (Deren,2005). In today's context, where environmental risks have become a critical determinant of financial performance, sustainability reports inevitably incorporate financial information, making them an integral part of corporate financial reporting. Consequently, supervising sustainable information disclosure has emerged as a key responsibility of audit committees. For example, in 2022, the U.S. SEC's Draft Standard for Climate Data Disclosure by Public Companies explicitly authorized audit committees to oversee corporate climate risks. Similarly, China's revised Measures for the Disclosure of Information by Listed Companies (2021) mandates audit committees to monitor directors' and senior management's compliance with disclosure obligations.

These developments demonstrate that, during the phase of high-quality green transition, audit committees are entrusted with broader environmental risk prevention functions. However, environmental disclosure reports encompass not only financial data but also highly specialized non-financial information, including environmental impact assessments, pollutant monitoring, and treatment processes. Such information often exhibits subjective, abstract, and flexible characteristics, making manipulation difficult to detect. As a result, audit committee members are required to possess specialized expertise to effectively oversee these disclosures (Bilal et al.,2018).

An audit committee with environmental expertise can effectively mitigate corporate greenwashing practices. First, such committees help counteract managers' short-sighted tendencies through enhanced environmental awareness. Executives often exhibit limited rationality due to technical constraints, resource limitations, and professional experience, which can lead to short-term decision-making. Independent directors with environmental backgrounds on audit committees are well-versed in industry-specific disclosure standards and eco-technology advancements. Through continuous oversight and communication with management, these directors help executives recognize environmental risks in corporate operations and remain informed about cutting-edge technologies and best practices. Moreover, environmentally oriented independent directors can act as structural holes in social networks, leveraging collaborative resources to secure green certifications for firms (Qiu & Yu,2023). This comprehensive approach addresses corporate green development challenges (Aras & Crowther,2008), improves actual environmental performance, and ultimately prevents speculative greenwashing behaviors.

Second, the environmental expertise of audit committee members can reduce corporate green agency costs and restrain greenwashing. As noted by Connelly et al. (2011) information asymmetry between internal and external stakeholders, coupled with managerial information dominance and incentive conflicts, creates opportunities for opportunistic greenwashing. Independent directors with environmental backgrounds strengthen environmental oversight and safeguard corporate reputations. Drawing on their experience and resource advantages, these directors enhance corporate governance by accurately evaluating firms' true environmental performance. By performing internal control and information supervision functions, they increase transparency, limit managerial information power, and promptly detect greenwashing practices. This exerts a deterrent effect on management, reduces green agency costs, and effectively curbs opportunistic environmental reporting behaviors.

Finally, the environmental expertise of audit committees can foster corporate green innovation and mitigate greenwashing. Green innovation is fundamental to achieving high-quality sustainable development. Strong green innovation performance not only

provides firms with a competitive advantage in the green economy but also drives sustainable development and supports high-quality environmental reporting (Xiao et al.,2024). An environmental perspective within audit committees helps counteract managerial short-sightedness and prevents opportunistic behavior in environmental investments (Ma et al.,2025). Independent directors with environmental expertise leverage their professional knowledge to provide managers with access to industry-leading technologies and partner resources, facilitating the identification of synergistic technological integration paths that align corporate performance with environmental objectives (Tu et al.,2024). By proactively applying technological upgrades throughout the corporate value chain, these directors pursue long-term value creation through green innovation while effectively restraining greenwashing behaviors.

Based on the above discussion, the following hypotheses are proposed:

Hypothesis 1: The environmental background of the audit committee can restrain corporate greenwashing behaviors.

Hypothesis 1-1: The environmental awareness of the audit committee can reduce managerial short-sightedness and curb corporate greenwashing behaviors.

Hypothesis 1-2: The environmental expertise of the audit committee can restrain corporate greenwashing by reducing green agency costs.

Hypothesis 1-3: The environmental expertise of the audit committee can promote green innovation and curb corporate greenwashing behaviors.

4 . Methodology

4.1 Data and Samples

This study employs a sample of A-share listed companies on the Shanghai and Shenzhen Stock Exchanges from 2010 to 2022. Data on corporate environmental [①] information disclosure are obtained from the Bloomberg database [②], an internationally recognized and authoritative rating agency, while corporate environmental performance data are sourced from the Huazheng ESG Rating Index. Information on audit committee members' backgrounds and tenure, as well as corporate governance characteristics, financial indicators, and green innovation data, are collected from the China Stock Market and Accounting Research (CSMAR) database and the China Research Data Service Platform (CNRDS). Based on these data sources, the following screening procedures were implemented: (1) firms designated with special treatment status (ST and ST*) were excluded; (2) observations with missing key variables were removed;

This study selects Bloomberg ESG to evaluate environmental information disclosure levels because it is the only authoritative institution providing ESG disclosure ratings, a system that has gained global recognition among scholars (Yu et al., 2020).

The Huazheng ESG rating system comprehensively addresses information concealed in corporate self-disclosures, providing a more authentic reflection of ESG performance. The scientific validity of using Huazheng ESG ratings to evaluate corporate ESG performance has gained widespread academic recognition (Xie Hongjun and Lü Xue, 2022).

(3) firms listed for less than one year were excluded; (4) firms in the financial and insurance industries were excluded; and (5) industries with fewer than 10 firm-year observations were excluded. Additionally, to mitigate the potential influence of outliers on the empirical results, all continuous variables were subjected to 1% tail trimming at both ends of the distribution.

4.2 Measures

4.2.1 Dependent Variables

Following Yu et al. (2020), this study defines *greenwashing* as the discrepancy between a firm's environmental information disclosure and its actual environmental performance, with a larger discrepancy indicating more severe greenwashing behavior. Specifically, the environmental disclosure level is measured using the environmental disclosure score (E-score) from the Bloomberg ESG database (*Evrindis*), which ranges from 0 to 100, with higher values indicating better disclosure quality. Corporate environmental performance is measured using the environmental rating (E-rating) from the China Securities ESG ratings (*Evronper*), which is classified into grades from C to AAA. These grades are converted into numerical scores ranging from 1 to 9, with higher scores indicating better environmental performance. To control for industry-level heterogeneity, both the Bloomberg ESG environmental disclosure scores and the China Securities ESG environmental performance ratings are standardized by industry. The difference between the standardized disclosure score and the standardized performance score is then calculated to construct the greenwashing measure, as shown in Model (1). A higher value of the greenwashing variable indicates a greater degree of greenwashing behavior.

$$Greenwashing = \frac{(Evrondis - \overline{Evrondis})}{\sigma_{dis}} - \frac{(Evronper - \overline{Evronper})}{\sigma_{pre}} \quad (1)$$

4.2.2 Independent Variables

The key explanatory variable, *Envron*, captures the environmental background of audit committee members. Following the methodology of Gong et al. (2025), this study manually identifies whether audit committee members possess environmental backgrounds by examining publicly disclosed profiles of audit committee members in listed companies, based on their academic qualifications and professional experience. Specifically, members holding environmental-related degrees or having prior or current employment in environmental regulatory agencies, environmental enterprises, or environmental non-governmental organizations (NGOs) are classified as having environmental backgrounds. The variable *Envron* is assigned a value of 1 if the audit committee includes at least one independent director with an environmental background, and 0 otherwise.

4.2.3 Control Variables

In line with established research (Fleitas Castillo et al.,2025;Hu et al.,2026;Mei et al.,2025), we control for firm characteristics, ownership structure, corporate governance factors, and industry-specific factors. Furthermore, industry fixed effects (μ)and year fixed effects (δ) were both controlled for in the model.Comprehensive definitions for all variables utilized in this study are presented inin Table 1.

Table 1 Names and Definitions of Primary Variables

Type of variables	Variables	Symbol expected	Measurement
Independent variables	Greenwash	*Creenwash*	Calculated from formula (2)
Moderator variable	Environmental background of audit committee	*Envron*	A dummy variable is set to 1 if the audit committee includes an environmental director, otherwise it is 0.
Control variables	Company size	*Size*	Ln(total assets)
	Asset-liability ratio	*Lev*	total liabilities to total assets
	Conversion rate	*Cashflow*	net cash flow from operating activities/total assets
	CEO power	*Daul*	A dummy variable with a value of 1 if the CEO also serves as the chairman, otherwise 0.
	Stock concentration	*Top1*	majority stake
	Net interest on assets	*Roa*	Net profit / (Total assets at the beginning of the year + Total assets at the end of the year) / 2
	Listing duration	*Age*	Ln(Launched Years)
	Degree of industry competition	*HHI*	The sum of the squares of the ratios of main business revenue to industry main business revenue
	Whether it is a heavily polluting enterprise	*Pollution*	A dummy variable: 1 if the company is in a heavily polluting industry, otherwise 0.
	Size of audit committee	*Scale*	number of members of the Board of Auditors
	Proportion of female directors	*Female*	Percentage of female directors on the board
	Independence of audit committee	*Independence*	proportion of independent directors in the audit committee
	Board busy	*Meeting*	Number of board meetings
	Property right nature	*State*	A dummy variable where the actual controller is the government is set to 1, otherwise to 0.

4.3 Empirical Model

To examine how the environmental background of audit committees affects corporate greenwashing, this study constructs the following benchmark regression model:

$$Greenwashing_{i,t} = \alpha_0 + \alpha_1 \times Envron_{i,t} + \alpha_x \times Controls_{i,t,x} + \mu + \delta + \varepsilon_{i,t} \quad (2)$$

In Model (2), *i* and *t* denote firm and year, respectively. The dependent variable, *Greenwashing*, measures the extent of corporate greenwashing.

5. Empirical Result

5.1 Descriptive Statistics

Table 2 reports the descriptive statistics of the main variables. The mean value of the greenwashing measure is -0.0176, with a median of -0.0454, a minimum of -2.4955, and a maximum of 3.2212. The standard deviation is 1.1026, indicating substantial variation in greenwashing behavior across firms. These results suggest that greenwashing represents a strategic disclosure practice adopted by some enterprises, with considerable inter-firm heterogeneity, thereby providing a solid foundation for subsequent empirical analysis. The mean value of *Envron* is 0.1155, indicating that approximately 11% of the listed firms in the sample have audit committees that include members with environmental backgrounds. The remaining control variables fall within reasonable ranges and are consistent with those reported in prior studies.

Table 2 Descriptive Statistics

Variable	Observed value	Least value	Median	Crest value	Average value	Standard error
Creenwash	11231	-2.4955	-0.0454	3.2212	-0.0176	1.1026
Envron	11231	0	0	1	0.1155	0.3196
Size	11231	20.4052	23.0359	26.9384	23.1444	1.3089
Lev	11231	0.0695	0.4892	0.8943	0.4776	0.1992
Cashflow	11231	-0.1445	0.0559	0.2614	0.0594	0.0701
Daul	11231	0	0	1	0.2038	0.4028
Top1	11231	8.2200	35.6400	77.1300	37.0269	16.3560
Roa	11231	-0.1829	0.0402	0.2199	0.0467	0.0594
lnage	11231	0	2.7081	3.3673	2.4855	0.6761
*HHI_A_*	11231	0.0412	0.1451	1	0.1998	0.1998
Pollution	11231	0	0	1	0.2795	0.4488
Scale	11231	2	3	6	3.4559	0.8850
Female	11231	0	0.1111	0.7143	0.1328	0.1237
Independence	11231	0.2000	0.6667	1	0.6638	0.1224
Meeting	11231	4	9	27	10.3235	4.3158
State	11231	0	1	1	0.5184	0.4997

5.2 Multiple Regression Analysis: Audit Committee's Environmental Background and Greenwashing

Tables 3 (1)-(3) indicate the regression results under specifications with no

controls, with control variables, and with both industry and year fixed effects, respectively. Across all specifications, the coefficient on *Envron* is negative and statistically significant at the 1% level. Economically, the presence of environmental expertise on audit committees is associated with an 11.5% reduction in corporate greenwashing. These benchmark results support Hypothesis H1, indicating that audit committees with environmental backgrounds effectively restrain corporate greenwashing and serve as an important governance mechanism for improving green governance and the quality of environmental disclosures.

Table 3 Benchmark Regression

variable	(1)	(2)	(3)
	Greenwash	*Greenwash*	*Greenwash*
Envron	-0.087***	-0.110***	-0.115***
	(-2.652)	(-3.379)	(-3.490)
Size		0.083***	0.079***
		(7.780)	(6.712)
Lev		-0.270***	-0.345***
		(-4.066)	(-4.750)
Cashflow		0.176	0.244
		(1.072)	(1.450)
Daul		0.090***	0.095***
		(3.422)	(3.599)
Top1		-0.001	-0.001
		(-1.195)	(-1.454)
Roa		0.236	0.169
		(1.110)	(0.772)
lnage		-0.116***	-0.133***
		(-6.639)	(-7.130)
*HHI_A_*		0.269***	0.433***
		(4.561)	(6.058)
Pollution		0.011	0.007
		(0.442)	(0.227)
Scale		0.013	0.012
		(0.970)	(0.908)
Female		-0.157*	-0.208**
		(-1.874)	(-2.433)
Independence		0.108	0.125
		(1.109)	(1.267)
Meeting		0.004	0.004

		(1.627)	(1.614)
State		-0.091***	-0.082***
		(-3.642)	(-3.230)
Constant	-0.008	-1.672***	-1.656***
	(-0.686)	(-7.490)	(-6.367)
Year	No	No	Yes
Industry	No	No	Yes
N	11231	11231	11231
Adj_R2	0.001	0.019	0.021

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.3 Robustness Test

5.3.1. Endogeneity Test

(1) Instrumental Variable Method

The instrumental variables include the proportion of listed firms within the same industry that have environmental audit committees (*INDR*) and the frequency of environmental-related terms in local government work reports (*Gov*). Columns (1) and (2) of Table 4 report the instrumental variable estimation results. The first-stage F-statistic is 53.622, exceeding the conventional threshold of 10. The Cragg-Donald Wald F-statistic equals 67.293, which is higher than the Stock−Yogo critical value of 19.93 at the 10% maximal IV size, indicating no weak instrument concern. The overidentification tests further support instrument validity: the p-values of the Sargan and Basmann tests are 0.2891 and 0.2901, respectively, suggesting that the instruments are exogenous. First-stage results show that both *INDR* and *Gov* are statistically significant, satisfying the relevance condition. In the second stage, the coefficient on *Envron* remains significantly negative at the 5% level, confirming that audit committees' environmental background continues to exert a significant restraining effect on corporate greenwashing.

(2) Heckman Two-Stage Regression

To address potential sample self-selection bias arising from missing ratings by external agencies, this study applies the Heckman two-stage procedure. In the first stage, the industry-average level of audit committee environmental background and local environmental attention are used as exogenous variables to estimate a Probit model, based on the control variables in Model (1), to capture firms' likelihood of appointing audit committee members with environmental backgrounds. The inverse Mills ratio (IMR) is then computed and included in Model (1). As reported in Column (2) of Table 4, after controlling for IMR, the coefficient on *Envron* remains significantly negative at

the 1% level, indicating that audit committees' environmental background continues to exert a significant restraining effect on corporate greenwashing.

(3) Propensity Score Matching (PSM)

To further mitigate selection bias stemming from systematic differences between firms with and without environmentally experienced audit committees, this study employs a propensity score matching approach. A 1:1 nearest-neighbor matching with a caliper of 0.05 is implemented to construct comparable treatment and control groups. The regression results in Column (4) of Table 4 show that the coefficient on *Envron* is significantly negative at the 1% level, further confirming that the environmental background of audit committees significantly reduces corporate greenwashing practices.

Table 4 Endogeneity Test

variable	(1)	(2)	(3)	(4)
	Envron	*Greenwash*	*Greenwash*	*Greenwash*
Envron		-0.708**	-0.106***	-0.150***
		(-2.315)	(-3.185)	(-3.463)
INDR	0.697***			
	(10.122)			
Gov	1.953**			
	(2.401)			
IMR			0.214***	
			(2.640)	
Size	0.002	0.080***	0.080***	0.114***
	(0.699)	(6.702)	(6.791)	(4.523)
Lev	0.052***	-0.311***	-0.290***	-0.363**
	(2.613)	(-4.122)	(-3.855)	(-2.324)
Cashflow	0.106**	0.306*	0.350**	0.002
	(2.219)	(1.768)	(2.030)	(0.005)
Daul	0.019**	0.105***	0.111***	0.097*
	(2.277)	(3.830)	(4.093)	(1.837)
Top1	-0.001***	-0.001*	-0.002**	-0.001
	(-2.801)	(-1.792)	(-2.070)	(-0.572)
Roa	-0.041	0.154	0.134	-0.055
	(-0.658)	(0.695)	(0.611)	(-0.123)
lnage	-0.012**	-0.141***	-0.146***	-0.129***
	(-2.267)	(-7.323)	(-7.566)	(-3.259)
*HHI_A_*	-0.051***	0.400***	0.364***	0.487***
	(-3.094)	(5.375)	(4.752)	(2.668)
Pollution	0.013	0.015	0.019	-0.068

	(1.449)	(0.500)	(0.631)	(-1.201)
Scale	0.027***	0.028*	0.039**	0.033
	(7.130)	(1.815)	(2.349)	(1.183)
Female	0.016	-0.199**	-0.192**	-0.369**
	(0.628)	(-2.297)	(-2.246)	(-2.140)
Independence	0.149***	0.215**	0.281**	0.262
	(6.013)	(1.981)	(2.484)	(1.197)
Meeting	0.001	0.005*	0.005*	0.001
	(1.353)	(1.827)	(1.929)	(0.239)
State	-0.022***	-0.094***	-0.104***	-0.143***
	(-2.968)	(-3.564)	(-3.912)	(-2.647)
Constant	-0.248***	-1.791***	-2.411***	-2.853***
	(-3.879)	(-6.588)	(-6.245)	(-5.224)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	11231	11231	11231	2592
Adj_R2	0.049		0.021	0.028
Cragg-Donald Wald F value	67.293			
Sargan test	1.124(0.2891)			
Basmann test	1.119(0.2901)			

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.3.2. Other Robustness Tests

(1) Variable substitution. To alleviate potential bias arising from the use of a binary indicator for audit committee environmental background (*Envron*), this study replaces the key explanatory variable with the proportion of audit committee members with environmental backgrounds (*Envron_r*) and the number of such members (*Envron_n*) in the baseline regressions. As shown in Columns (1) and (2) of Table 5, the coefficients on *Envron_r* and *Envron_n* are both significantly negative at the 1% level, indicating that audit committee environmental background continues to significantly reduce corporate greenwashing.

(2) Excluding heavily polluting firms. Given that firms in heavily polluting industries are subject to more stringent regulatory scrutiny, which may affect the results, these firms are excluded from the sample and the baseline regression is re-estimated. As reported in Column (3) of Table 5, the coefficient on *Envron* remains significantly

negative at the 5% level, suggesting that the restraining effect of audit committee environmental background on greenwashing is robust to the exclusion of high-pollution industries.

(3) One-period lag of independent variables. To further address potential spillover effects, all independent variables are lagged by one period before re-estimating the baseline model. As shown in Column (4) of Table 5, the coefficient on *Envron* remains significantly negative at the 1% level, confirming the robustness of the main findings.

(4) Controlling for executives' environmental backgrounds. To mitigate omitted-variable bias, this study adds CEO environmental background (*CEO_Envron*) and chairman environmental background (*Chairman_Envron*) as additional control variables in the baseline regression. As shown in Column (5) of Table 5, the coefficient on *Envron* remains significantly negative at the 1% level, indicating that audit committee environmental background independently constrains corporate greenwashing.

(5) Controlling for regional heterogeneity. To account for potential regional influences, regional fixed effects and their interaction terms with industry fixed effects are further included in the baseline regression. As reported in Columns (6) and (7) of Table 5, the coefficient on *Envron* remains significantly negative at the 1% level, suggesting that the results are not driven by regional heterogeneity.

(6) Excluding potential policy effects. To control for the impact of major environmental policies, such as the implementation of China's 2015 Environmental Protection Law, a policy indicator (*Policy*) and its interaction term with audit committee environmental background (*Envron* × *Policy*) are incorporated into the regression. As shown in Columns (8)–(10) of Table 5, including regressions excluding the 2015 sample, adding Policy, and further incorporating the interaction term, the coefficient on *Envron* remains significantly negative at the 1% level, indicating that the main findings are robust to policy-related effects.

(7) Alternative measurement of greenwashing. To address concerns regarding the measurement of the dependent variable, this study replaces the Huazheng ESG rating with the Wind ESG rating to reconstruct the greenwashing measure (*Greenwash2*) and re-estimates the baseline model. As shown in Column (11) of Table 5, the coefficient on *Envron* remains significantly negative at the 1% level, further confirming the robustness of the results.

Table 5 Other Robustness Tests

variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Greenwash	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash*	*Greenwash2*
Envron_r	-0.369***										
	(-3.810)										

Envron_n		-0.169***									
		(-3.775)									
Envron			-0.091**		-0.083**	-0.103***	-0.082**	-0.115***	-0.115***	-0.094	-0.124***
			(-2.231)		(-2.454)	(-3.138)	(-2.515)	(-3.370)	(-3.490)	(-1.258)	(-3.634)
L.Envron				-0.144***							
				(-3.890)							
CEO_Envron					-0.230***						
					(-5.056)						
*Chairman_*					-0.018						
Envron					(-0.424)						
Policy									0.122*	0.123*	
									(1.841)	(1.858)	
Envron×										-0.025	
Policy										(-0.306)	
Size	0.079***	0.079***	0.096***	0.076***	0.080***	0.078***	0.068***	0.081***	0.079***	0.079***	0.055***
	(6.687)	(6.697)	(6.662)	(5.952)	(6.727)	(7.167)	(5.911)	(6.560)	(6.712)	(6.710)	(4.507)
Lev	-0.344***	-0.344***	-0.327***	-0.354***	-0.346***	-0.347***	-0.244***	-0.343***	-0.345***	-0.345***	-0.227***
	(-4.741)	(-4.734)	(-3.776)	(-4.499)	(-4.726)	(-4.654)	(-3.129)	(-4.506)	(-4.750)	(-4.752)	(-3.002)
Cashflow	0.245	0.245	0.376*	0.152	0.229	0.243	0.114	0.319*	0.244	0.244	0.169
	(1.458)	(1.455)	(1.953)	(0.829)	(1.353)	(1.380)	(0.645)	(1.820)	(1.450)	(1.452)	(0.963)
Daul	0.095***	0.095***	0.138***	0.077***	0.111***	0.086***	0.077***	0.091***	0.095***	0.095***	0.122***
	(3.625)	(3.607)	(4.576)	(2.688)	(4.192)	(3.160)	(2.778)	(3.307)	(3.599)	(3.598)	(4.382)
Top1	-0.001	-0.001	-0.002**	-0.001	-0.001	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001
	(-1.441)	(-1.469)	(-2.415)	(-1.188)	(-1.427)	(-1.692)	(-1.352)	(-1.347)	(-1.454)	(-1.454)	(-0.676)
Roa	0.171	0.171	0.214	0.290	0.144	0.249	0.325	0.179	0.169	0.169	0.292
	(0.781)	(0.780)	(0.845)	(1.241)	(0.649)	(1.082)	(1.406)	(0.779)	(0.772)	(0.773)	(1.295)
lnage	-0.133***	-0.133***	-0.160***	-0.139***	-0.137***	-0.160***	-0.162***	-0.137***	-0.133***	-0.133***	-0.136***
	(-7.108)	(-7.133)	(-7.517)	(-6.081)	(-7.246)	(-8.642)	(-8.288)	(-6.959)	(-7.130)	(-7.121)	(-6.967)
*HHI_A_*	0.431***	0.432***	0.501***	0.510***	0.435***	0.462***	0.385***	0.417***	0.433***	0.432***	-0.016
	(6.041)	(6.049)	(6.407)	(6.342)	(6.049)	(6.467)	(4.840)	(5.564)	(6.058)	(6.058)	(-0.230)
Pollution	0.007	0.007		0.020	0.007	0.020	0.004	0.003	0.007	0.007	0.037
	(0.221)	(0.244)		(0.646)	(0.240)	(0.666)	(0.136)	(0.093)	(0.227)	(0.225)	(1.194)
Scale	0.009	0.013	0.017	0.013	0.014	0.005	0.008	0.012	0.012	0.012	0.021
	(0.689)	(0.950)	(1.052)	(0.933)	(1.072)	(0.362)	(0.609)	(0.856)	(0.908)	(0.908)	(1.484)
Female	-0.209**	-0.209**	-0.111	-0.248***	-0.212**	-0.210**	-0.197**	-0.186**	-0.208**	-0.208**	-0.266***
	(-2.445)	(-2.439)	(-1.119)	(-2.708)	(-2.459)	(-2.404)	(-2.190)	(-2.081)	(-2.433)	(-2.433)	(-2.954)
Independence	0.128	0.127	0.151	0.139	0.133	0.168*	0.141	0.190*	0.125	0.125	0.151
	(1.304)	(1.291)	(1.351)	(1.278)	(1.341)	(1.860)	(1.539)	(1.856)	(1.267)	(1.268)	(1.477)

Meeting	0.004	0.004	-0.001	0.006*	0.005*	0.006**	0.006**	0.005	0.004	0.004	0.004
	(1.629)	(1.628)	(-0.438)	(1.944)	(1.914)	(2.368)	(2.245)	(1.589)	(1.614)	(1.614)	(1.520)
State	-0.083***	-0.083***	-0.035	-0.097***	-0.085***	-0.096***	-0.100***	-0.080***	-0.082***	-0.082***	-0.083***
	(-3.267)	(-3.249)	(-1.176)	(-3.506)	(-3.305)	(-3.594)	(-3.580)	(-3.014)	(-3.230)	(-3.220)	(-3.121)
Constant	-1.644***	-1.656***	-1.983***	-1.622***	-1.673***	-1.446***	-1.255***	-1.735***	-1.656***	-1.656***	-1.060***
	(-6.322)	(-6.367)	(-6.414)	(-5.743)	(-6.370)	(-6.173)	(-5.013)	(-6.394)	(-6.367)	(-6.367)	(-3.990)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	No	No	No	No	No	Yes	Yes	No	No	No	No
Region × Industry	No	No	No	No	No	No	Yes	No	No	No	No
N	11231	11231	8092	9661	11052	11227	11216	10233	11231	11231	11231
Adj_R²	0.021	0.021	0.027	0.021	0.024	0.041	0.096	0.021	0.021	0.021	0.014

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.4. Mechanism Testing

This study employs stepwise regression to test the proposed mechanisms. Based on Model (1), the following mediation test models are specified:

$$Mediator_{i,t} = \beta_0 + \beta_1 \times Rnvron + \beta_x \times Control_{i,t,x} + \mu + \delta + \varepsilon_{i,t} \quad (3)$$

$$Greenwashing_{i,t} = \gamma_0 + \gamma_1 \times Envron_{i,t} + \gamma_2 \times Mediator_{i,t} + \gamma_x \times Controls_{i,t,x} + \mu + \delta + \varepsilon_{i,t} \quad (4)$$

Models (3) and (4) include $Mediator_{i,t}$ as the mediator variable. If the coefficients β_1 in Models (3) and γ_2 Models (4) are both significant, $\beta_1 \times \gamma_2$ and α_1 their signs align with those in the benchmark regression, this indicates the mediation effect is valid.

5.4.1 Short-sightedness of management

To examine the mediating role of managerial short-sightedness, we use the *ShortV* metric (Short-term Vision), derived from the management discussion and analysis (MD&A) sections of listed companies' annual reports, following Dong et al. (2023). Higher *ShortV* values indicate greater managerial short-sightedness. As shown in Table 6, columns (1) and (2), the audit committee's environmental background has a significantly negative effect on *ShortV* at the 5% level, while *ShortV* exhibits a significantly positive effect on Greenwashing at the 1% level. These results indicate that environmental awareness can reduce managerial short-sightedness, thereby mitigating corporate greenwashing, supporting Hypothesis H1-1.

5.4.2 Green Agency Cost

The mediating role of green agency costs is assessed using the approach of Deng

et al. (2024), measuring Green Agency Costs (*GreenAC*) as the ratio of environmental governance expenses to operating revenue in management expense breakdowns. Higher *GreenAC* values reflect more severe green agency problems. As shown in Table 6, columns (3) and (4), Environmental Governance (*Envron*) significantly reduces *GreenAC* at the 5% level, and *GreenAC* significantly increases Greenwashing at the same level. This suggests that an audit committee's environmental background mitigates green agency problems, thereby curbing greenwashing, supporting Hypothesis H1-2.

5.4.3 Green Innovation

The mediating role of green innovation is examined using the natural logarithm of green invention patent applications (*GreenINN*) as a proxy, following Yousaf et al. (2023). Higher *GreenINN* values indicate stronger corporate investment in green innovation. As shown in Table 6, columns (5) and (6), the audit committee's environmental background positively influences *GreenINN* at the 1% level, while *GreenINN* negatively affects Greenwashing at the same significance level. These findings demonstrate that an environmentally knowledgeable audit committee enhances corporate green innovation capabilities, thereby reducing greenwashing, supporting Hypothesis H1-3.

Table 6 Mechanism Testing

variable	(1) *ShortV*	(2) *Greenwash*	(3) *GreenAC*	(4) *Greenwash*	(5) *GreenINN*	(6) *Greenwash*
Envron	-0.005**	-0.112***	-0.056**	-0.122***	0.134***	-0.108***
	(-2.118)	(-3.399)	(-2.448)	(-3.695)	(3.955)	(-3.299)
ShortV		0.423***				
		(3.044)				
GreenAC				0.030**		
				(2.342)		
GreenINN						-0.050***
						(-5.134)
Size	0.002**	0.076***	-0.016*	0.075***	0.513***	0.105***
	(2.205)	(6.483)	(-1.774)	(6.286)	(43.157)	(8.328)
Lev	0.022***	-0.349***	-0.075	-0.302***	0.008	-0.345***
	(4.020)	(-4.802)	(-1.052)	(-4.146)	(0.112)	(-4.745)
Cashflow	0.022	0.223	-0.006	0.214	-0.355**	0.226
	(1.637)	(1.328)	(-0.033)	(1.269)	(-2.106)	(1.345)
Daul	-0.007***	0.098***	0.051*	0.103***	0.057**	0.098***

	(-4.025)	(3.709)	(1.898)	(3.900)	(2.138)	(3.712)
Top1	0.000*	-0.001	0.002***	-0.001	-0.001**	-0.001
	(1.834)	(-1.531)	(2.862)	(-1.423)	(-2.101)	(-1.555)
Roa	-0.122***	0.226	-0.664***	0.248	0.545**	0.196
	(-6.660)	(1.032)	(-2.693)	(1.133)	(2.531)	(0.898)
lnage	0.013***	-0.138***	0.102***	-0.139***	-0.090***	-0.138***
	(9.298)	(-7.336)	(7.248)	(-7.419)	(-5.287)	(-7.376)
*HHI_A_*	-0.005	0.439***	0.076	0.450***	-0.284***	0.418***
	(-0.868)	(6.158)	(1.431)	(6.218)	(-3.769)	(5.830)
Pollution	0.008***	0.004	0.272***	-0.002	-0.180***	-0.002
	(3.845)	(0.144)	(9.068)	(-0.080)	(-6.538)	(-0.081)
Scale	0.002*	0.012	0.051***	0.006	-0.011	0.012
	(1.937)	(0.876)	(4.038)	(0.442)	(-0.881)	(0.867)
Female	-0.003	-0.211**	-0.173**	-0.203**	-0.339***	-0.225***
	(-0.462)	(-2.467)	(-2.106)	(-2.368)	(-4.060)	(-2.637)
Independence	0.003	0.126	-0.066	0.120	0.109	0.130
	(0.471)	(1.279)	(-0.928)	(1.216)	(1.239)	(1.323)
Meeting	-0.001***	0.005*	-0.007***	0.005*	0.008***	0.005*
	(-7.475)	(1.767)	(-3.617)	(1.876)	(2.933)	(1.760)
State	0.010***	-0.087***	-0.005	-0.084***	0.126***	-0.076***
	(5.052)	(-3.408)	(-0.222)	(-3.299)	(5.033)	(-2.978)
Constant	0.022	-1.619***	0.612***	-1.552***	-11.267***	-2.221***
	(1.157)	(-6.243)	(2.856)	(-5.898)	(-43.218)	(-8.010)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	11225	11225	11049	11049	11231	11231
Adj_R2	0.136	0.021	0.065	0.022	0.432	0.023

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5. Heterogeneity Test

5.5.1 Property Rights Heterogeneity

State-owned enterprises (*SOEs*), due to their inherent social responsibility, enjoy easier access to policy and financial resources. However, SOEs' controlling enterprises face higher reputational risks from environmental violations, which generally reduces their incentive to engage in greenwashing. In contrast, non-SOEs, lacking such institutional advantages, prioritize economic performance over environmental

compliance, making them more likely to resort to strategic greenwashing in policy and resource competition. This underscores the need for stronger green governance in non-SOEs. Accordingly, this study categorizes firms into SOEs and non-SOEs based on actual controllers and conducts benchmark regression analyses. As shown in Table 7, columns (1) and (2), the environmental protection background of audit committees significantly mitigates corporate greenwashing in non-SOEs.

Table 7 Property Rights Heterogeneity Test

	(1)	(2)
	state-owned enterprise	non-state-owned
	Greenwash	*Greenwash*
Envron	-0.078(-1.575)	-0.153***(-3.470)
Size	0.096***(5.914)	0.055***(3.065)
Lev	-0.602***(-5.827)	-0.013 (-0.121)
Cashflow	0.387(1.629)	0.158(0.661)
Daul	-0.007(-0.138)	0.136***(4.343)
Top1	-0.000(-0.154)	-0.003***(-2.831)
Roa	-0.435(-1.219)	0.652**(2.323)
lnage	-0.084***(-2.619)	-0.173***(-7.096)
*HHI_A_*	0.598***(5.431)	0.304***(3.000)
Pollution	-0.033(-0.794)	0.030(0.709)
Scale	-0.000(-0.007)	0.039*(1.808)
Female	-0.264*(-1.894)	-0.135(-1.233)
Independence	0.228*(1.712)	0.006(0.039)
Meeting	0.002(0.398)	0.005(1.347)
Constant	-2.140***(-5.939)	-1.223***(-3.080)
Year	Yes	Yes
Industry	Yes	Yes
N	5822	5409
Adj_R2	0.022	0.022

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5.2 Reputation of the Audit Committee

The effectiveness of audit committees relies on reputation mechanisms (Fama & Jensen,1983), which incentivize them to actively perform supervisory and advisory roles. Higher audit committee reputation therefore strengthens their capacity to curb greenwashing through environmental protection expertise. Following Farah et al.

(2024), audit committee reputation capital is measured using social network degree centrality, with firms categorized into high- and low-reputation groups based on annual industry averages. Benchmark regressions reveal, as shown in Table 8, columns (1) and (2), that the anti-greenwashing effect of audit committees' environmental protection backgrounds is more pronounced among high-reputation committees.

Table 8 Audit Committee Reputation Heterogeneity Test

	(1)	(2)
	High reputation	Low reputation
	Greenwash	*Greenwash*
Envron	-0.139***(-3.289)	-0.085 (-1.632)
Size	0.125*** (8.294)	0.013 (0.695)
Lev	-0.439*** (-4.413)	-0.215** (-2.014)
Cashflow	0.130 (0.571)	0.377 (1.503)
Daul	0.045 (1.252)	0.161*** (4.090)
Top1	-0.001 (-1.092)	-0.001 (-0.999)
Roa	0.218 (0.736)	0.098 (0.298)
lnage	-0.133*** (-5.227)	-0.140*** (-5.044)
*HHI_A_*	0.392*** (3.933)	0.466*** (4.500)
Pollution	0.013 (0.323)	-0.008 (-0.188)
Scale	0.005 (0.301)	0.026 (1.222)
Female	-0.261** (-2.279)	-0.132 (-1.017)
Independence	0.081 (0.614)	0.186 (1.277)
Meeting	0.003 (0.776)	0.008* (1.874)
State	-0.108*** (-3.167)	-0.032 (-0.837)
Constant	-2.291*** (-6.565)	-0.689* (-1.718)
Year	Yes	Yes
Industry	Yes	Yes
N	6509	4722
Adj_R2	0.027	0.024

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5.3 CEO's Authority

The audit committee's supervisory role is moderated by CEO authority, as excessive power may undermine oversight effectiveness. Consequently, the environmental audit committee's capacity to curb greenwashing is stronger when CEO authority is limited. CEO authority is assessed based on concurrent roles as chairman:

holding the chair indicates high power, whereas absence indicates low power. Benchmark regression analyses for high- and low-CEO-power groups, shown in Table 9, columns (1) and (2), demonstrate that the environmental audit committee's anti-greenwashing effect is more significant when CEO power is low.

Table 9 CEO Power Heterogeneity Test

	(1)	(2)
	Power is great.	Power is small
	Greenwash	*Greenwash*
Envron	-0.010(-0.143)	-0.149***(-4.008)
Size	0.047*(1.801)	0.085***(6.416)
Lev	0.092(0.585)	-0.459***(-5.552)
Cashflow	0.496(1.300)	0.172(0.920)
Top1	-0.002(-1.479)	-0.001(-1.049)
Roa	0.529(1.213)	0.033(0.132)
lnage	-0.087**(-2.164)	-0.150***(-7.024)
*HHI_A_*	0.208(1.211)	0.445***(5.676)
Pollution	-0.033(-0.506)	0.023(0.697)
Scale	-0.018(-0.517)	0.018(1.267)
Female	0.156(0.934)	-0.327***(-3.290)
Independence	-0.017(-0.076)	0.152(1.388)
Meeting	0.009(1.562)	0.003(1.084)
State	-0.278***(-4.408)	-0.052*(-1.842)
Constant	-1.262**(-2.212)	-1.625***(-5.524)
Year	Yes	Yes
Industry	Yes	Yes
N	2289	8942
Adj_R2	0.026	0.022

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5.4 Environmental Governance System

A robust environmental governance system provides the institutional foundation for the audit committee's environmental information oversight. Consequently, firms with well-established green governance systems are likely to exhibit a stronger effect of the audit committee's environmental background in curbing corporate greenwashing. Following Li et al. (2019), the sample is divided into two groups based on environmental governance performance: firms implementing green management innovations (identified through environmental supervision and certification disclosures)

and those without such practices. Classification criteria include the establishment of environmental management systems, ISO14001/9001 certifications, environmental education and training programs, or special environmental campaigns. Benchmark regressions, reported in columns (1) and (2) of Table 10, show that the environmental background of audit committee members significantly reduces greenwashing in firms with effective environmental governance systems.

Table 10 Heterogeneity Test of Environmental Governance System

	(1) Good environmental governance system *Greenwash*	(2) Poor environmental governance system *Greenwash*
Envron	-0.144*** (-3.542)	-0.055 (-1.010)
Size	0.131*** (8.731)	-0.031 (-1.588)
Lev	-0.351*** (-3.633)	-0.305*** (-2.908)
Cashflow	-0.081 (-0.344)	0.650*** (2.855)
Dual	0.059* (1.661)	0.133*** (3.488)
Top1	-0.002* (-1.916)	0.000(0.435)
Roa	0.595**(2.008)	-0.348(-1.118)
lnage	-0.203***(-8.179)	-0.005(-0.195)
HHI	0.471*** (4.577)	0.397***(4.178)
Pollution	0.042(1.169)	-0.082(-1.632)
Scale	-0.005(-0.308)	0.037*(1.853)
Female	-0.388***(-3.484)	0.091(0.706)
Independence	0.063(0.514)	0.129 (0.852)
Meeting	0.005 (1.286)	0.005(1.272)
State	-0.067**(-1.972)	-0.107***(-2.911)
Constant	-2.642***(-7.803)	0.352 (0.850)
Year	Yes	Yes
Industry	Yes	Yes
N	7430	3801
Adj_R2	0.035	0.027

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5.5 Green Finance Development

Corporate greenwashing is partly motivated by access to green financial resources. In regions with abundant green finance, competition for traditional financial resources may decrease, potentially incentivizing firms to engage in greenwashing to secure green

funds. Hence, the inhibitory effect of audit committees' environmental background on greenwashing may be more pronounced where green finance development is high. FollowingLiu & He (2021), green finance development is measured using green credit: the proportion of total interest expenses, excluding the six high-energy-consuming industries, in each province. Based on annual provincial averages, the sample is divided into high- and low-development groups for benchmark regressions. Results in Table 11 (Columns (1 and 2) show that the anti-greenwashing effect of audit committees' environmental background is stronger in regions with higher green finance development.

Table 11 Heterogeneity Test of Green Finance Development Level

	(1)	(2)
	The level of green finance development is high.	Low level of green finance development
	Greenwash	*Greenwash*
Envron	-0.127*** (-3.215)	-0.089 (-1.494)
Size	0.129*** (8.616)	-0.008 (-0.432)
Lev	-0.351*** (-3.782)	-0.118 (-1.005)
Cashflow	0.302 (1.356)	0.136 (0.528)
Dual	0.077** (2.309)	0.112*** (2.584)
Top1	-0.001 (-1.069)	-0.001 (-1.276)
Roa	-0.162 (-0.575)	1.164*** (3.284)
lnage	-0.129*** (-5.331)	-0.162*** (-5.398)
HHI	0.417*** (4.526)	0.373*** (3.255)
Pollution	-0.053 (-1.370)	0.062 (1.351)
Scale	0.003 (0.166)	0.022 (1.146)
Female	0.006 (0.056)	-0.531*** (-3.759)
Independence	0.107 (0.812)	0.122 (0.847)
Meeting	0.005 (1.448)	0.004 (0.798)
State	-0.094*** (-2.793)	-0.083** (-2.100)
Constant	-2.376*** (-6.630)	0.368 (0.870)
Year	Yes	Yes
Industry	Yes	Yes
N	6611	4620
Adj_R2	0.034	0.026

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

5.5.6. Economic Consequences

Green governance aims to enhance environmental management performance. This study examines whether the environmental protection background of audit committees can reduce greenwashing and improve environmental governance outcomes. Using the Green Governance Performance Index (*Greengovperf*) from Gao et al. (2026) as the dependent variable, an interaction term (*Envron* × *Greenwash*) is constructed. The results in column (1) of Table 12 show that the regression coefficient of *Greenwash* is negative and significant at the 1% level for *Greengovperf*, confirming that greenwashing undermines corporate environmental governance performance. The results in column (2) of Table 12 indicate that the regression coefficient of *Envron* × *Greenwash* on *Greengovperf* is significantly positive at the 10% level, suggesting that an audit committee's environmental background mitigates the adverse effect of greenwashing and thus improves overall environmental governance performance.

Table 12 Economic Consequences Test

	(1)	(2)
	Greengovperf	*Greengovperf*
Greenwash	-0.090*** (-23.334)	-0.092*** (-22.397)
Envron		0.034**(2.563)
Envron×*Greenwash*		0.019* (1.693)
Size	0.025*** (5.580)	0.025*** (5.536)
Lev	0.079** (2.503)	0.078** (2.467)
Cashflow	-0.000 (-0.002)	-0.005 (-0.066)
Dual	-0.022* (-1.901)	-0.023** (-1.994)
Top1	0.001*** (3.526)	0.001*** (3.608)
Roa	0.061 (0.600)	0.064 (0.632)
lnage	-0.010 (-1.252)	-0.009 (-1.197)
HHI	-0.068** (-2.240)	-0.066** (-2.179)
Pollution	0.080*** (6.764)	0.080*** (6.753)
Scale	-0.001 (-0.116)	-0.001 (-0.271)
Female	0.039 (1.075)	0.039 (1.066)
Independence	0.089** (2.413)	0.082** (2.217)
Meeting	-0.001 (-1.296)	-0.001 (-1.346)
State	0.010 (0.906)	0.010 (0.926)
Constant	-0.141 (-1.420)	-0.129 (-1.300)
Year	Yes	Yes
Industry	Yes	Yes
N	9612	9612
Adj_R^2	0.099	0.100

Note: The t-values in parentheses indicate significance levels of 10%,5%, and 1% respectively, with asterisks (*) and double asterisks (**) denoting these thresholds. The analysis employs robust standard errors calculated at the firm level.

6. Discussion

This study provides empirical evidence that audit committees with environmental expertise significantly reduce corporate greenwashing, which aligns with and extends existing theoretical frameworks. The findings support the notion that specialized knowledge within governance structures can reshape corporate behavioral patterns by enhancing the credibility and substantiveness of environmental disclosures.

Our mechanism analysis reveals that the suppression of greenwashing operates through three interrelated pathways: mitigating managerial short-termism, lowering green agency costs, and fostering green innovation. These findings resonate with behavioral decision theory and agency theory, suggesting that environmental expertise enables audit committees to counteract managerial myopia and opportunism in environmental reporting. Moreover, the results complement prior research emphasizing external regulatory mechanisms (Seele & Gatti,2017;Zhang,2022) by highlighting the importance of internal governance in achieving environmental accountability.

The heterogeneity analyses further contextualize these effects. The stronger inhibitory impact observed in non-state-owned enterprises, firms with high-reputation audit committees, and those operating under weaker CEO power underscores the role of institutional and organizational contingencies. This aligns with Fama and Jensen's (1983) emphasis on reputation mechanisms and supports the idea that governance effectiveness is contingent on the interplay of internal control and external legitimacy.

However, several limitations should be acknowledged. The study focuses exclusively on Chinese A-share listed firms, which may limit the generalizability of findings to other institutional settings. In addition, while the measure of environmental background is based on educational and professional experience, future research could incorporate more nuanced indicators of expertise, such as practical accomplishments in environmental management or relevant certifications.

7. Conclusion and Implications

This study demonstrates that audit committees with environmental expertise significantly curb corporate greenwashing through three mechanisms: mitigating managerial short-termism, reducing green agency costs, and promoting green innovation. The effects are particularly pronounced in non-state-owned firms, companies with high-reputation audit committees, and contexts where CEO power is balanced. These findings highlight the critical role of specialized governance expertise in enhancing environmental accountability.

The results offer important implications for practice and policy. Corporations should prioritize appointing environmentally qualified directors to audit committees and integrate green governance into their oversight frameworks. Regulators can strengthen guidance on audit committee composition and link policy incentives to robust internal governance systems. Future research should explore cross-country comparisons and dynamic interactions between audit committees and other governance bodies.

Data availability

Audit committee members' environmental background data is collected manually, all other data can be found in the CSMAR database. The datasets generated during the current study are available in the database: https://data.csmar.com/;

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