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Behind the green veil: board characteristics, greenwashing, and the fraud triangle

Jingzhuo Yu^{1,2} & Yong-Sik Hwang²✉

This study examines the relationship between board characteristics and environmental, social, and governance (ESG) greenwashing among Chinese A-share listed companies from 2009 to 2023, based on 13,246 firm-year observations from 1,380 firms. Using ordinary least squares regression, six board characteristics are analyzed: gender diversity, independence, director tenure, meeting frequency, size, and CEO duality. Results show that higher proportions of female and independent directors, longer average tenure, lower meeting frequency, and separation of CEO–chairperson roles are associated with significantly less greenwashing, whereas board size has no significant effect. Economic significance analysis reveals that director tenure and independence exert the greatest impact, while female representation, meeting frequency, and CEO duality exert smaller yet meaningful effects. Heterogeneity analysis indicates that media attention moderates the board–greenwashing relationship through governance and legitimacy pressure mechanisms. The study contributes by (1) applying fraud triangle theory to the board–greenwashing nexus, incorporating tenure and meeting frequency for the first time; (2) quantifying the economic magnitude of key board attributes to provide a cost-effective governance roadmap; and (3) introducing a framework that captures media attention’s dual-mechanism effects. The findings suggest that differentiated oversight strategies aligned with internal governance structures can enhance ESG authenticity.

¹Jiaxingnanhu University, Jiaxing, China. ²Sejong University, Seoul, Republic of Korea. ✉email: yhwang@sejong.ac.kr

Introduction

The environmental, social, and governance (ESG) framework aligns closely with global sustainability objectives by providing essential mechanisms for advancing environmental protection and sustainable development initiatives (Li et al. 2024). Consequently, ESG has garnered increasing attention from governments worldwide. In China, specifically, extensive ESG-related policies have been developed and implemented to facilitate the achievement of national carbon peak and carbon neutrality targets (Zhang et al. 2023).

While ESG practices have gained prominence in China and are becoming increasingly integral to investment decisions in the country, the implementation of the ESG or corporate social responsibility (CSR) framework remains in its early stages (Chen and Dagestani, 2023). Ethical awareness also remains underdeveloped. This developmental gap creates significant incentives for Chinese publicly traded firms to engage in ESG greenwashing, which offers a cost-effective way of influencing stakeholder perceptions and securing financial advantages in capital markets (Long et al. 2025). However, being exposed after greenwashing inflicts severe reputational damage (Nyilasy et al. 2014), erodes market competitiveness (Szabo and Webster, 2021), reduces sales performance and diminishes firm value (Chen et al. 2025). Moreover, greenwashing negatively affects consumers, markets and society (Xia et al. 2023). Therefore, research is urgently needed to identify effective mechanisms for curbing greenwashing.

The board of directors is a key mechanism in corporate governance and the primary decision-making body in corporate strategy. Existing research indicates that board characteristics significantly influence the formulation of sustainable development strategies (Lagasio and Cucari 2019). With the integration of corporate-governance theory and sustainable development concepts, increasing attention has been paid to the relationship between board governance, CSR and ESG strategies. While substantial research exists on the links between corporate governance and CSR, significantly fewer studies have explored the connection between corporate governance, particularly board governance, and ESG policy implementation. Even more pronounced is the knowledge gap concerning ESG greenwashing, which remains notably under-researched. Taking China as an example, in the latest research on the relationship between board characteristics and ESG greenwashing, recent evidence shows that female directors generally help curb greenwashing (Liu 2024; Zahid et al. 2025), independent directors can reduce the level of greenwashing (L. Ma et al. 2025), board faultlines and greenwashing exhibit a U-shaped relationship (X. Ma et al. 2025), and there are board-network peer effects of greenwashing (Chen et al. 2025). These advances enrich the understanding of the “board–greenwashing” relationship, but they mostly focus on single variables and lack a systematic examination of multiple board characteristics within a unified framework. At the same time, the external environment (e.g., media attention) has also been shown to affect greenwashing (Long et al. 2025), but the literature often treats internal and external governance factors in isolation, and the mechanism by which external contexts moderate the above linear relationships remains to be clarified.

Based on the above gap, the research objective of this paper is: within a unified analytical framework, simultaneously evaluate the effects of multidimensional board characteristics—gender diversity, independence, tenure, meeting frequency, size, and CEO duality—on ESG greenwashing and identify the moderating role of external governance conditions such as media attention, thereby revealing the interaction mechanism between internal governance and external oversight. To this end, we propose the following research questions:

RQ1: How do these board characteristics respectively affect ESG greenwashing?

RQ2: How does media attention moderate the above relationships?

This paper uses data on Chinese listed companies to study the above questions. Concentrating on China is justified due to several factors. First, as enterprises within the planet’s foremost developing nation and emerging economy, Chinese companies operate within a distinctive institutional environment when progressing towards sustainability and fulfilling their broader corporate responsibilities (Li and Chen 2024). Compared to what happens in developed countries, in China, ESG information disclosure standards are inconsistent, embryonal and without robust greenwashing governance mechanisms and regulations (Liao et al. 2023; Long et al. 2025). Furthermore, China’s capital market is dominated by small investors (Ang et al. 2021), who are at an informational disadvantage and lack the analytical and processing capabilities to accurately and promptly detect greenwashing. This allows Chinese companies greater room for greenwashing; it also offers a valuable backdrop for studying greenwashing in developing countries. Second, the institutional reform of Chinese enterprises is still in progress, and the governance structures of their boards remain underdeveloped (Chen and Dagestani 2023). Regarding board characteristics, the uniqueness and complexity of corporate governance in China provide a rich source of material for examining greenwashing.

This study investigated the influence of six key board characteristics on greenwashing. The findings show that gender-diverse, independent boards with longer tenures were more likely to curb greenwashing, whereas boards that held frequent meetings and had CEO duality were more likely to encourage greenwashing. However, there was no significant linear relationship between size and greenwashing. Moreover, the effectiveness of board governance mechanisms varied with media attention. Specifically, gender diversity and independence more effectively mitigated greenwashing under media scrutiny. However, this environment amplified the promotional effects of meeting frequency and CEO duality on greenwashing.

This study advances the greenwashing literature in three ways. First, theoretically, we integrate multiple board attributes into the Fraud Triangle Theory (FTT) framework and map them onto its dimensions of pressure, opportunity, and rationalization. This moves beyond single-attribute analyses—e.g., gender diversity (Eliwa et al. 2023), independence (Yu et al. 2020), size (Gidage et al. 2024), or CEO duality (Mohapatra et al. 2025)—by offering a unified explanatory lens. We further extend FTT to the ESG context by theorizing—and testing—the moderating role of media attention as an external governance condition that shifts board–greenwashing relationships via legitimacy pressure and heightened monitoring, responding to calls to incorporate external governance environments into board research (Moreno-Ureba et al. 2025). Second, empirically, using a large panel of Chinese listed firms, we provide early evidence on director tenure and meeting frequency in relation to greenwashing. We find that more frequent meetings are, counterintuitively, associated with greater greenwashing—consistent with the board-inefficiency/symbolic-response view (Abdullah et al. 2024; Vafeas 1999) and in contrast to evidence from some emerging-market settings that report beneficial effects (Disli et al. 2022). By examining China, we also broaden a literature centered on developed markets (Fleitas-Castillo et al. 2025; Moreno-Ureba et al. 2025; Pisano et al. 2025). Third, methodologically, addressing concerns that management research often privileges statistical over economic significance (McCloskey and Ziliak, 1996; Rommel and Weltin 2021), we report both p-values and economic magnitudes. We

show that tenure and independence have economically meaningful effects, whereas the effects of female representation, meeting frequency, and CEO duality, although statistically significant, are modest in economic terms.

The remainder of this article is organized as follows. In Section 2, we review the literature, discuss the study's theoretical underpinnings and present the research hypotheses. In Section 3, the study's methodological framework is described. Section 4 contains the empirical findings, regression outcomes, and examination of the study's robustness and heterogeneity. Finally, in Section 5, we draw the main conclusions, consider the theoretical and practical implications, and acknowledge the study's limitations.

Literature review and hypothesis development

Literature review. Greenwashing refers to misleading environmental claims that create discrepancies between stated CSR standards and actual performance, a phenomenon known as CSR decoupling (Gull et al. 2023a). In the ESG context, this manifests as firms prioritizing symbolic initiatives over substantive efforts, strategically manipulating disclosures to obscure poor ESG performance (Han and Song 2025; Jiang et al. 2024; Li et al. 2024).

Scholars working on corporate ESG greenwashing have identified two primary categories of drivers: external governance and internal governance factors. External factors include mandatory policies, government regulations, self-regulatory organizations, voluntary agreements and pressure from market participants and intermediaries; internal factors comprise board structure and executive characteristics (Liu et al. 2024). However, in the literature, the focus is predominantly on external governance elements. In addition to their direct impacts on ESG greenwashing, as illustrated by media's role in reducing greenwashing (Z. Zhang et al. 2025), these elements also have significant moderating effects and heterogeneous influences, which have been demonstrated by numerous studies. For example, high media scrutiny enhances the effectiveness of digital transformation in reducing greenwashing (Lu et al. 2023).

Although internal and external determinants of ESG greenwashing are equally significant, research on internal governance mechanisms remains insufficient (Chen 2024). Existing work on internal drivers of greenwashing predominantly focuses on developed markets. European studies indicate that board independence, board gender diversity, and CSR committee presence are associated with substantial reductions in environmental decoupling (Pisano et al. 2025), while an inverted U-shaped relationship exists between the number of female directors and greenwashing (Fleitas-Castillo et al. 2025). Evidence from the United States demonstrates that narcissistic CEO leadership increases greenwashing propensity (Abdullah et al. 2025), whereas female directors tend to mitigate environmental decoupling (Moreno-Ureba et al. 2025). Cross-national research across 41 countries reveals that CSR committee presence is negatively associated with CSR decoupling (Gull et al. 2023b). In the Chinese context, research examining board composition and ESG greenwashing remains limited and predominantly focuses on single-dimensional board attributes such as female directors and independent directors (Liu 2024; L. Ma et al. 2025; Zahid et al. 2025). While X. Zhang et al. (2025) demonstrate that board diversity (gender, academic discipline, and university background) reduces CSR decoupling, comprehensive evidence on board-greenwashing relationships is scarce. Furthermore, research examining how external factors moderate internal governance mechanisms or produce heterogeneous effects across different contexts is virtually absent. This study addresses this critical gap by investigating these interactions, thereby offering

valuable insights for both theoretical advancement and practical applications in corporate governance.

Theoretical background. We conceptualize ESG greenwashing as a spectrum from intentional deception to unintentional symbolic compliance (e.g., strategic vagueness, reporting blind spots). This framing does not presuppose intent yet captures decoupling between ESG “talk” and “action.” FTT remains applicable because its enabling conditions—pressure, opportunity, and rationalization—operate irrespective of intent and yield the same stakeholder outcome: misleading environmental information (Cressey 1953).

Under FTT, pressure reflects legitimacy demands from stakeholders and regulators (Suchman 1995); when ESG performance is weak, firms may inflate or fabricate claims to avert sanctions (Baldini et al. 2018; Berrêdo et al. 2024). Opportunity arises from information asymmetry and weak oversight, for example through hard-to-read ESG reports that overload users and obscure negatives, or through deficient internal and external monitoring (Wang et al. 2018). Rationalization denotes cognitive reframing that renders manipulation acceptable (Ghafoor et al. 2019; Ren et al. 2024), drawing on narratives such as financing constraints (Zhang 2022a), rating subjectivity (Hu et al. 2023), sustainability “incrementalism,” and isomorphic or peer pressures (Chen et al. 2025; Lamb et al. 2020; Zhou and Lei 2025). These mechanisms collectively foster a “greenwashing without fraud” self-persuasion loop.

Because reducing any one condition lowers misconduct risk (Schnatterly et al. 2018), board governance is a natural locus for suppression. Consistent with agency theory, effective boards—particularly independent and female directors—constrain managerial opportunism and shrink opportunity (Bravo and Reguera-Alvarado 2019; Harjoto et al. 2015; Rao and Tilt 2016). In line with resource dependence theory (Pfeffer, 1972), boards supply networks and reputational capital that strengthen stakeholder engagement and ESG performance, alleviating pressure and dampening greenwashing incentives (Ellili, 2023; Hasan et al. 2018; Lee and Raschke, 2023; Liao et al. 2018; Orzalin and Baydauletov, 2020; Sun et al. 2025). Given its implicit and relatively stable nature, rationalization is difficult to observe and measure (Kurpierz and Smith 2020; Liu et al. 2024); accordingly, our empirical focus is on pressure and opportunity.

In summary, as shown in Table 1, we adopt FTT as the organizing lens and map related perspectives onto its pressure–opportunity–rationalization (P–O–R) triad. Legitimacy and stakeholder theories account for the pressure by explaining why firms face external demands for ESG conformity and symbolic compliance, whereas resource dependence theory explains how firms alleviate that pressure by cultivating boundary-spanning ties and securing critical resources. Agency theory and information asymmetry clarify opportunity by showing how weak monitoring and opaque information environments enable strategic ESG disclosure. Gender socialization, reputation, and diffusion of responsibility perspectives illuminate rationalization by shaping ethical sensitivity, expected reputation losses, and perceived individual accountability. This integration reduces theoretical dispersion, keeps FTT at the core, and uses ancillary theories only insofar as they refine mechanisms within the P–O–R framework.

Hypotheses. The theoretical model framework is shown in Fig. 1. Below, we explore the relationship between corporate governance and ESG greenwashing from six aspects: gender diversity, independence, director tenure, meeting frequency, board size, and CEO duality.

Table 1 Integration of Fraud Triangle Theory with Supplementary Theories.

FTT Dimension	Supplementary Theory	Mechanism (FTT Mapping)	Applied to Board Characteristics
Pressure	Legitimacy theory	Explains why firms face stakeholder pressure to demonstrate environmental commitment	All characteristics
	Stakeholder theory	Identifies specific stakeholder groups that exert environmental pressure	All characteristics
	Resource dependence theory	Explains how directors' resources and networks help firms secure support and reduce pressure	Female directors, independent directors, director tenure, board size
	Faultline theory	Gender-based subgroups reduce cohesion and stall consensus, escalating stakeholder conflict	Female directors
Opportunity	Agency theory	Principal-agent conflict creates need for monitoring; weak oversight enables opportunistic behavior	All characteristics
	Information asymmetry theory	Management's information advantage over board creates opportunities for undetected deception	Independent directors, director tenure, board meetings
	Faultline theory	Gender subgroups can diminish cohesion and delay consensus, weakening oversight	Female directors
Rationalization	Gender socialization theory	Women's higher ethical sensitivity and rule compliance reduce propensity to rationalize unethical behavior	Female directors
	Critical mass theory	When female representation is below critical mass, it serves as a moral credential—softening ethical concerns, legitimizing embellishment, and routinizing symbolic compliance	Female directors
	Reputation theory	Concern for reputation in director labor market constrains rationalization of greenwashing	Independent directors
	Diffusion of responsibility	Dispersed responsibility in large boards reduces moral constraints on rationalization	Board size

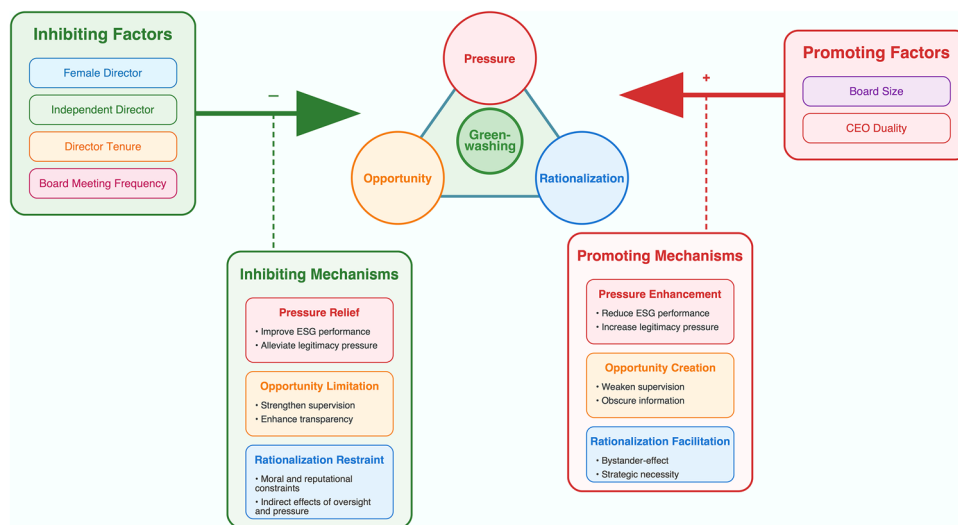


Fig. 1 Theoretical model framework.

Gender diversity. Based on FTT, female directors may suppress greenwashing by reducing pressure, opportunity, and rationalization. First, the reputation and external connections held by female directors enable them to positively influence ESG or CSR performance (Dicuonzo et al. 2024; Khatri 2023; Mallidis et al. 2024; Paolone et al. 2024), thereby enhancing the organization's legitimacy in the eyes of stakeholders and alleviating related pressure (Liao et al. 2018; Yu et al. 2025). Second, female directors can strengthen the board's supervisory capacity. Through higher meeting attendance rates, thorough preparation for meetings, and greater participation in oversight-related committees, they enhance the board's supervision of corporate information disclosure, improve disclosure quality, and thus reduce the opportunity for management to engage in greenwashing (Jain and Zaman 2020). Lastly, female directors demonstrate greater sensitivity to ethical issues. Gender socialization theory explains behavioral differences between men and women (Gilligan 1977),

indicating that women are more likely to comply with rules and less likely to engage in unethical behavior than men (Heubeck 2024). Therefore, compared to male directors, female directors are less likely to rationalize greenwashing behavior.

Conversely, women's presence may unintentionally facilitate greenwashing through all three elements of fraud triangle theory. On the pressure dimension, faultline dynamics make gender subgroups salient, eroding cohesion and slowing collective responses to stakeholder needs, which heightens legitimacy pressures (X. Ma et al. 2025). On the opportunity dimension, the same fragmentation weakens monitoring and delays consensus, expanding room for opportunistic ESG disclosure. On the rationalization dimension, female representation below critical mass is often used by management as a "moral credential," which weakens ethical concerns about inflated ESG disclosure and reframes it as low-risk external communication or an industry norm, thereby normalizing symbolic compliance (Khatri 2023).

Evidence is consistent with these mechanisms, including findings that low or token female representation coincides with greater decoupling (Fleitas-Castillo et al. 2025; Wang et al. 2025).

In light of these competing theoretical perspectives, we propose alternative hypotheses:

H1a: Board gender diversity is negatively associated with ESG greenwashing.

H1b: Board gender diversity is positively associated with ESG greenwashing.

Board independence. Independent directors are instrumental in mitigating greenwashing by addressing all three components of FTT. First, regarding opportunity, as internal supervisory agents with fewer conflicts of interest, independent directors hold a unique advantage in safeguarding shareholder interests against fraudulent environmental claims. When constituting the majority of the board, their independence enhances supervisory effectiveness (Gull et al. 2023a), significantly reducing the opportunity for greenwashing by strengthening oversight mechanisms. Furthermore, independent directors play a crucial role in alleviating information asymmetry and improving corporate transparency (Armstrong et al. 2014; Nicolo' and Andrades-Peña 2024), which directly diminishes the opportunity element of the fraud triangle by creating an environment where deceptive environmental practices are more likely to be detected. Second, concerning pressure, independent directors provide new resources and insights, and leverage their networks and business expertise to successfully respond to stakeholder demands (Uyar et al. 2020). Their presence is positively associated with genuine ESG performance (Dicuonzo et al. 2024), which alleviates the pressures to misrepresent environmental credentials. By facilitating legitimate environmental improvements, independent directors reduce the pressure component of the fraud triangle that might otherwise drive companies toward greenwashing to meet stakeholder expectations. Finally, addressing rationalization, independent directors place high importance on their personal reputation and are generally unwilling to engage in unethical behavior that may damage their professional image. Unlike other directors who may be more susceptible to rationalizing deceptive practices, independent directors find it more difficult to justify corporate greenwashing behavior (Campanella et al. 2021; Liao et al. 2018). Their presence thus weakens the rationalization element of the fraud triangle by introducing ethical standards that make it harder for the organization to mentally justify fraudulent environmental claims. Based on the above analysis, we propose:

H2: Board independence is negatively associated with ESG greenwashing.

Board tenure. Drawing on FTT, extended board tenure can help mitigate corporate greenwashing by primarily influencing the elements of pressure and opportunity. First, from the perspective of reducing pressure, directors with longer tenure accumulate substantial firm-specific knowledge and professional skills, which enhance their ability to allocate resources optimally and respond effectively to stakeholder demands (Patro et al. 2018). This heightened competence helps alleviate the legitimacy pressures that often motivate greenwashing, as experienced directors are better equipped to build genuine stakeholder trust and achieve authentic CSR outcomes (Padungsaksawasdi and Treepongkaruna 2024). Second, in terms of reducing opportunity, long-tenured directors exhibit stronger oversight capabilities and greater resistance to managerial influence and peer pressure (Paolone et al. 2023), thereby limiting the structural opportunities for greenwashing. Furthermore, extended board tenure promotes more frequent and effective communication between the board and management, reducing information asymmetry and further

diminishing the chances for deceptive ESG practices (Rutherford and Buchholtz 2007). Thus, by simultaneously reducing the two elements of greenwashing, long board tenure serves as an important internal anti-greenwashing mechanism. Based on the above analysis, we propose:

H3: Board tenure is negatively associated with ESG greenwashing.

Board meeting frequency. Drawing on FTT, board meeting frequency can be regarded as a governance mechanism that primarily influences the “opportunity” and “pressure” components of the theory. First, more frequent meetings tighten board oversight, shortening information gaps between directors and management and increasing the probability that questionable ESG claims are detected (Abdullah et al. 2024; Disli et al. 2022). This additional scrutiny directly constrains the opportunity for greenwashing by raising the likelihood and cost of discovery. Second, regular meetings allow directors to address evolving stakeholder expectations and legitimate performance concerns in a timely manner, improve sustainable performance, thereby easing the pressure that might otherwise motivate symbolic ESG disclosures (Jarboui et al. 2023; Uyar et al. 2020).

However, an alternative perspective suggests that board meetings may instead increase greenwashing. From the FTT perspective, frequent board meetings can facilitate greenwashing through three distinct mechanisms. First, regarding pressure, high external legitimacy pressure may motivate firms to employ frequent meetings as a symbolic strategy to signal environmental commitment to stakeholders, thereby enhancing reputation without substantive action. This creates incentives for symbolic rather than substantive environmental initiatives. Evidence suggests that boards may only superficially prioritize sustainability issues while focusing primarily on traditional governance agendas (Abdullah et al. 2024). Moreover, higher board meeting frequency tends to promote procedural climate governance initiatives that emphasize processes and disclosure rather than substantive performance improvements (Nicolo' and Andrades-Peña, 2024; Orazalin et al. 2024). Consequently, external ESG narratives strengthen while substantive performance lags, widening the disclosure–performance gap and manifesting as intensified greenwashing. Second, concerning opportunity, frequent board meetings may paradoxically signal weak governance effectiveness. As Vafeas (1999) suggests, high meeting frequency may indicate operational inefficiency, bureaucratic dysfunction, and resource wastage, thereby creating conditions conducive to greenwashing. Third, regarding rationalization, frequent meetings may provide directors with a moral alibi—a rationalization mechanism rooted in the ritual of regular convening—leading them to believe they have exercised robust oversight despite limited substantive scrutiny. Consistent with this concern, research indicates that lower board meeting frequency is positively associated with moral reputation (Baselga-Pascual et al. 2018).

Given these competing theoretical perspectives, we propose the following alternative hypotheses:

H4a: The frequency of board meetings is negatively associated with ESG greenwashing.

H4b: The frequency of board meetings is positively associated with ESG greenwashing.

Board size. From an FTT perspective, the effect of board size on greenwashing is theoretically ambiguous because board size can shift opportunity and pressure in opposite directions, with secondary implications for rationalization.

On the one hand, larger boards may increase greenwashing. First, regarding opportunity, based on agency theory, when

boards grow too large, coordination frictions, diluted accountability, and “free rider” tendencies can impair timely monitoring (Dicuonzo et al. 2024; Gidage et al. 2024). This bureaucratic drag weakens the board’s ability to scrutinize ESG disclosures, thereby widening the structural opportunity for managers to misstate sustainability achievements (Sauerwald and Su, 2019). Second, regarding pressure, large boards often lack cohesion and struggle to reach swift consensus, which delays strategic responses to stakeholder demands and undermines environmental sustainability performance, thereby heightening legitimacy pressure (Disli et al. 2022; Ghosh et al. 2023). That added pressure can intensify managers’ motivation to resort to symbolic or misleading ESG claims to satisfy short-term expectations. Finally, rationalization also has a certain secondary effect. Due to the bystander-effect (Darley and Latane 1968), the diffusion of responsibility inherent in oversized boards makes it easier for individual directors to rationalize inaction—“someone else is watching”—providing a subtle psychological pathway to justify greenwashing decisions.

On the other hand, larger boards may reduce greenwashing. First, regarding opportunity, larger boards can constrain greenwashing by enhancing governance effectiveness. Drawing on resource dependence theory, increased board size strengthens monitoring capacity, deepens expertise, and broadens networks, thereby raising the likelihood and cost of detecting misstatements in ESG claims (Treepongkaruna et al. 2024b). Larger boards also enable more robust committee structures and task specialization, facilitating closer scrutiny of ESG disclosures and performance. Second, concerning pressure, bigger boards broaden expertise and external ties, and are thus better able to identify and coordinate the needs of different stakeholders, thereby easing legitimacy pressure and reducing the motivation for deception (Zhu et al. 2024). Empirical work even links board size to better environmental and CSR performance (Padungsaksawasdi and Treepongkaruna 2024; Villiers et al. 2011).

Given these competing theoretical perspectives, we propose the following alternative hypotheses:

H5a: Board size is positively associated with corporate greenwashing.

H5b: Board size is negatively associated with corporate greenwashing.

CEO duality. From the standpoint of FTT, CEO duality heightens two of the three prerequisites for corporate greenwashing—opportunity and pressure—while also facilitating rationalization. When the same individual serves as both CEO and board chair, the boundary between management and oversight collapses, concentrating authority and diluting independent scrutiny (Fama and Jensen 1983). This structural fusion weakens internal checks and balances, thereby enlarging the opportunity for managers to manipulate ESG disclosures without timely detection (Agnese et al. 2024). Simultaneously, the absence of a counter-balancing chair amplifies the firm’s responsiveness to short-term managerial or shareholder demands, leads to the neglect of stakeholder interests in decision-making processes, intensifies conflicts with stakeholders, and increases legitimacy pressures and thus the motivation to engage in symbolic—or misleading—sustainability reporting when real performance lags (Khan et al. 2013; Padungsaksawasdi and Treepongkaruna 2024). Finally, the concentration of power enables executives to rationalize deceptive practices more easily, as they can frame such actions as necessary for strategic agility or shareholder value, completing the fraud triangle and elevating the risk of ESG greenwashing.

Recent research indicates that CEO duality is associated with more intensive earnings management and higher ESG disclosure, consistent with a strategic pattern of disclosure-based window

dressing (Mohapatra et al. 2025). Nevertheless, a minority of studies suggest the opposite; for example, Tagliatalata et al. (2024) report that CEO duality narrows the gap between communication and green practices. On balance, the preponderance of evidence supports a positive relation between CEO duality and greenwashing. Based on this literature, we propose the following hypothesis:

H6: CEO duality is positively associated with ESG greenwashing.

Methods

Sample. This study examined the listed companies on the A-shares from 2009 to 2023. The present study began in 2009 for two reasons. First, Huazheng ESG data for A-share listed companies became available only in 2009. Second, that year, the China Securities Regulatory Commission (CSRC) issued regulations to strengthen the supervision of listed securities companies to enhance the oversight of listed companies. The research data cutoff is 31 December 2023, as Bloomberg’s ESG disclosure scores for most A-share listed companies have not been updated for 2024. Additional data were sourced from the China Stock Market and Accounting Research Database. In line with standard practices, we excluded financial companies because of their distinct regulatory and disclosure requirements (Raimo et al. 2021). Furthermore, we excluded observations with missing key variables, companies designated as “ST” or “*ST” and firms that were listed for less than one year. Continuous variables were subjected to 1% winsorisation to mitigate the influence of outliers. Our final sample comprises 13,246 firm-year observations from 1,380 unique firms listed on the Shanghai and Shenzhen stock exchanges over the period 2009–2023. These sample firms represent approximately 82.1% of the total market capitalization of A-share listed companies as of year-end 2023 indicating substantial coverage of the Chinese equity market. The sample spans 73 industries, with the top five industries (Computer & Electronics Manufacturing, Pharmaceutical, Chemical Products, Real Estate, and Electrical Equipment) accounting for 31.07% of observations.

Measures

Dependent variable: ESG greenwashing score. Drawing on prior research (Chen et al. 2024; Liao et al. 2023), we determined the score of ESG greenwashing (GW) by calculating the difference between the ESG disclosure score (ESG_{dis}) and the ESG performance score (ESG_{per}). The following calculation formula was used:

$$GW_{i,t} = \frac{ESG_{dis\ i,t} - \overline{ESG_{dis}}}{\sigma_{dis}} - \frac{ESG_{per\ i,t} - \overline{ESG_{per}}}{\sigma_{per}}$$

Specifically, $ESG_{dis\ i,t}$ represents the ESG disclosure score of firm i in year t , sourced from the Bloomberg database, while $ESG_{per\ i,t}$ denotes the ESG performance score of firm i in year t , obtained from the Huazheng database. To enable meaningful comparison, both ESG disclosure and ESG performance scores are standardized using Z-scores, ensuring that their difference reasonably captures a firm’s greenwashing risk. A positive value of $GW_{i,t}$ indicates the presence of greenwashing behavior, with larger values reflecting more severe greenwashing risk. Conversely, $GW_{i,t} \leq 0$ suggests the absence of greenwashing.

We use the Bloomberg ESG Disclosure Score to measure firms’ ESG disclosure. The metric captures the extent of publicly disclosed ESG data rather than the quality or outcomes of ESG activities. It is an objective, transparency-based measure constructed from more than 900 disclosure indicators across environmental, social, and governance pillars—for example,

CO₂ emissions, energy use, water consumption, waste management, pollution control, renewable energy; workforce diversity, workplace safety, community relations; board meeting attendance and political contributions (Gidage et al. 2024). Indicators are weighted by importance and tailored to industry to ensure like-for-like comparisons. Data are compiled from public sources, including annual and sustainability reports, third-party research, press releases, and media coverage. Scores range from 0.1 to 100, with higher values indicating more extensive non-financial disclosure. Because both favorable and unfavorable items are counted, the score is suitable for analyzing potential greenwashing manifested through extensive reporting.

We use the Huazheng ESG Rating to proxy firms' realized ESG performance. Since 2009, Sino-Securities Index Information Service (Shanghai) Co.Ltd has systematically evaluated the ESG performance of Chinese A-share listed companies; its database covers all A-share listed companies, is updated quarterly, and is widely recognized as an important data resource for Chinese ESG research in China (Liao et al. 2023). Compared with international rating systems, the Huazheng ESG Rating system fully considers the uniqueness of China's capital market and the characteristics of various listed companies, integrating internationally recognized ESG principles with the Chinese local context. The system not only collects information publicly disclosed by companies but also integrates multi-source data from government departments, regulatory agencies, and news media, thereby more accurately reflecting the actual ESG performance of Chinese listed companies (Liu 2024). The Huazheng ESG Rating system adopts a top-down evaluation approach, focusing on 14 thematic categories and 26 key indicators that cover the environmental, social, and corporate governance dimensions. The rating adopts an industry-weighted averaging method, fully considering the particularities of different industries. The final ratings are divided into nine levels, from low to high: C, CC, CCC, B, BB, BBB, A, AA, and AAA. In this study, we assign these nine levels values from 1 to 9, with larger values indicating better ESG performance (Long et al. 2025).

Independent variables: board characteristics. Based on existing research (Abdelkader et al. 2024; Eliwa et al. 2023; Heubeck 2024; Keresztúri et al. 2025), the following six board characteristics are selected as independent variables: (1) the percentage of female board members (*Female*), (2) the percentage of independent board members (*Indep*), (3) the average number of months on the board (*Tenure*), (4) the total number of board meetings during the year (*Meeting*), (5) the number of board members (*Bsize*), and (6) CEO is also the chairperson or not (*Dual*). The detailed variables' definition is provided in Table A1 in the Appendix.

Control variables. This study used control variables at both the firm and regional levels, as shown in Table A1 of the Appendix. At the firm level, we first considered three key financial indicators: Leverage (*Lev*), which measures a firm's risk level, with higher leverage potentially correlating with increased unethical behavior, including ESG greenwashing (Treepongkaruna et al. 2024a); Return on Assets (*ROA*), which indicates profitability, as more profitable firms typically exhibit superior ESG performance and face less motivation to engage in ESG greenwashing (Eliwa et al. 2023); and Cash Flow Ratio (*Cashflow*), which reflects financial capacity, as firms with greater financial resources are more likely to demonstrate better CSR practices and sustainable development outcomes (Orazalin 2020). In addition, two corporate-governance variables were included: Management Shareholding Ratio (*Mshare*), which reflects potential agency problems and conflicts of interest in the firm. A higher management shareholding ratio reduces agency costs, promotes long-

term orientation and CSR, and diminishes greenwashing behavior (Bu et al. 2024). The other corporate-governance variable was Largest Shareholder Holding Rate (*Top1*), which represents ownership concentration and influences supervisory effectiveness and management's ESG decisions (Park et al. 2025). The other firm-level control variables were Firm Size (*Size*), Firm Age (*Age*) and State-Owned Enterprise (*SOE*). Scholars have found that larger and more established firms typically demonstrate superior ESG disclosure and performance compared to smaller and younger firms (Zhang 2022b). Ownership structure is also significant, as private firms, compared to SOEs, are less subject to environmental regulations and are thus more likely to engage in greenwashing (Liao et al. 2023). At the regional level, we chose Provincial Gross Regional Product (*GDP*) to account for the potential impact of regional economic disparities on ESG greenwashing (Sun et al. 2025).

Empirical model. In this study, we examined the relationship between board characteristics and greenwashing using the ordinary least squares (OLS) regression analysis (Mondal et al. 2023). To analyze the panel data, we employed a two-way fixed-effects model (year and industry). This approach mitigated the potential estimation bias stemming from omitted variables, unobservable industry-specific characteristics and temporal trends, thus strengthening causal inferences. Additionally, to account for potential correlations in firm-level error terms, we implemented firm-clustered standard errors, which enhanced the robustness of our findings (Du et al. 2024). We tested our theses using the following model:

$$GW_{i,t} = \alpha_0 + \alpha_1 Female_{i,t} + \alpha_2 Indep_{i,t} + \alpha_3 Tenure_{i,t} + \alpha_4 Meeting_{i,t} + \alpha_5 Bsize_{i,t} + \alpha_6 Dual_{i,t} + \alpha_7 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

where *Female_{i,t}*, *Indep_{i,t}*, *Tenure_{i,t}*, *Meeting_{i,t}*, *Bsize_{i,t}* and *Dual_{i,t}* are the explanatory variables; *GW_{i,t}* is the dependent variable; *Controls_{i,t}* are the control variables; μ_i captures firm fixed effects; λ_t captures year fixed effects; and ε is the random disturbance term. α_0 is a constant term; α_1 to α_6 are the coefficients of the explanatory variables, and α_7 is the coefficient of the control variables. In addition, standard errors are clustered at the firm level.

Empirical analysis

Descriptive statistics. Table 2 reports descriptive statistics. The *GW* index—where higher values indicate greater greenwashing—has a mean of -0.300 (median -0.336 ; min -2.853 ; max 2.790). The negative mean implies that, on average, firms in our sample are not greenwashing, with greenwashing concentrated in the right tail ($GW > 0$). At the same time, the mass of negative values also raises the possibility of greenhushing—i.e., conservative disclosure relative to environmental actions (De Novellis et al. 2025; Huang et al. 2025). Accordingly, *GW* should be interpreted as a measure of disclosure–performance misalignment rather than intent: positive scores suggest potential greenwashing, whereas negative scores may reflect either alignment or greenhushing. This distributional pattern makes the identification of board- and firm-level attributes that predict positive *GW* scores a more targeted and policy-relevant endeavor, while we acknowledge that measurement choices may contribute to the prevalence of negative values. The standard deviation (SD) of 1.227 exceeds the absolute mean, highlighting substantial cross-firm heterogeneity in ESG disclosure–performance alignment, consistent with (Zheng and Zhang 2024).

Regarding the board characteristics, *Female* averaged 0.134, surpassing the 0.108 reported by Eliwa et al. (2023) for China in

Table 2 Descriptive statistics.

Symbol	Observations	Mean	SD	Min.	Median	Max
GW	13,246	-0.300	1.227	-2.853	-0.336	2.790
Female	13,246	0.134	0.124	0.000	0.111	0.500
Indep	13,246	0.376	0.056	0.333	0.364	0.571
Tenure	12,802	48.920	18.593	16.000	46.333	105.733
Meeting	13,241	10.321	4.734	1.000	9.000	58.000
Bsize	13,246	8.989	1.877	3.000	9.000	18.000
Dual	12,841	0.211	0.408	0.000	0.000	1.000
Mshare	13,246	0.032	0.090	0.000	0.000	0.495
Top1	13,246	36.474	16.169	8.140	34.740	76.950
Size	13,246	23.231	1.311	20.499	23.128	26.955
Age	13,246	2.906	0.350	1.792	2.944	3.526
SOE	13,246	0.527	0.499	0.000	1.000	1.000
Lev	13,246	0.479	0.196	0.077	0.490	0.885
ROA	13,246	0.045	0.059	-0.176	0.039	0.220
Cashflow	13,246	0.061	0.069	-0.130	0.057	0.264
GDP	13,246	10.464	0.785	7.790	10.539	11.818

the period 2005–2019. *Indep* averaged 0.376, marginally exceeding the CSRC’s minimum requirement of one-third with minimal variation (SD = 0.056). *Tenure* averaged 48.92 months—approximately four years—which aligns with Guping et al. (2020)’s findings. *Meeting* approximately 10 times annually (mean = 10.321), which is consistent with the results of Anyigbah et al. (2023). The mean *Bsize* of 8.989 members falls between the recommended upper limits proposed in the literature: 8 members and 10 members (Jensen 1993; Lipton and Lorsch 1992). *Dual* had a mean of 0.211, indicating a limited prevalence of combined chairperson-CEO roles, which supports the observations of S. Wang et al. (2024). Table A2 in the Appendix presents the Pearson correlation coefficients and variance inflation factor (VIF) values for the variables. The VIF values ranged from 1.093 to 1.693, well below the conventional threshold of 3 (Seow 2025), suggesting that multicollinearity did not pose a significant problem in our analysis.

Regression results. To analyze the impact of various board attributes on greenwashing, we used three fixed-effects regression models (Table 3). The modelling approach involved gradually adding control variables across the three models to comprehensively assess the effects under different conditions. Model 1 included only the explanatory variables and the dependent variable. Model 2 comprised other non-financial firm-level variables as control variables, and Model 3 encompassed financial and regional economic variables as controls. The results of the three models show that *Female* is significantly negatively correlated with *GW*, supporting H1a and corroborating the findings of Eliwa et al. (2023). *Indep* is significantly negatively correlated with *GW*, supporting H2 and corroborating the findings of Yu et al. (2020). *Tenure* is significantly negatively correlated with *GW*, supporting H3. *Meeting* is significantly positively associated with *GW*, supporting H4b and aligns with Baselga-Pascual et al. (2018). *Meeting* is significantly positively correlated with *GW*, supporting H4b and aligning with Baselga-Pascual et al. (2018). However, the relationship between *Bsize* and *GW* is not statistically significant; this result fails to support H5a or H5b and is consistent with the findings of Keresztúri et al. (2025). The absence of a significant linear relationship may reflect competing mechanisms outlined by agency theory and resource dependence theory. Agency theory posits that increasing board size reduces monitoring efficiency, potentially heightening the likelihood of greenwashing. Meanwhile, the decision-making delays resulting from expanded board size may prevent timely responses to stakeholder demands,

Table 3 Main regression results.

	1	2	3
Symbol	Model 1	Model 2	Model 3
Female	-0.242** (-1.98)	-0.303** (-2.48)	-0.265** (-2.27)
Indep	-1.159*** (-4.08)	-1.105*** (-3.83)	-1.110*** (-3.92)
Tenure	-0.006*** (-8.18)	-0.007*** (-9.28)	-0.007*** (-8.89)
Meeting	0.014*** (4.09)	0.011*** (3.25)	0.008** (2.41)
Bsize	0.002 (0.24)	0.001 (0.06)	0.001 (0.07)
Dual	0.101*** (2.69)	0.093** (2.34)	0.080** (2.05)
Mshare		-0.416** (-2.08)	-0.250 (-1.32)
Top1		-0.001 (-0.77)	-0.000 (-0.07)
Size		0.042*** (2.58)	0.004 (0.23)
Age		0.175*** (2.90)	0.138** (2.35)
SOE		-0.194*** (-4.70)	-0.233*** (-5.79)
Lev			0.748*** (7.18)
ROA			-0.856*** (-3.05)
Cashflow			0.593*** (3.28)
GDP			-0.078*** (-3.27)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Constant	0.259 (1.49)	-0.996** (-2.47)	0.444 (0.95)
Observations	12,395	12,395	12,395
Adj R-squared	0.424	0.430	0.443

Robust t-statistics in parentheses.
***p < 0.01, **p < 0.05.

leading to increased legitimacy pressures and consequently heightened greenwashing motivation, albeit to a relatively minor degree. In contrast, resource dependence theory suggests that larger boards provide enhanced resources, facilitate stakeholder

Table 4 Endogeneity test.

	1	2	3	4
Symbol	GMM	2SLS-first stage	2SLS-second stage	PSM
L.GW	0.545*** (15.85)			
Female_mean		-0.595*** (-10.72)		
Female	-0.556** (-2.19)		-1.377** (-2.13)	-0.234* (-1.87)
Indep	-5.327** (-2.49)	0.002 (0.05)	-1.088*** (-3.77)	-1.335*** (-4.20)
Tenure	-0.007*** (-2.78)	0.000 (0.20)	-0.007*** (-8.59)	-0.007*** (-7.87)
Meeting	0.035*** (3.47)	0.000 (1.03)	0.009*** (2.64)	0.007* (1.94)
Bsize	-0.032 (-0.87)	-0.001 (-0.99)	-0.001 (-0.06)	0.001 (0.05)
Dual	2.895*** (3.59)	0.012** (2.02)	0.093** (2.31)	0.115*** (2.68)
Control	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry		Yes	Yes	Yes
Constant	-4.444 (-1.27)	0.349*** (5.50)		0.491 (0.98)
Observations	10,488	12,290	12,290	9284
Kleibergen-Paap rk LM statistic		64.006	68.150	
p-value		0		
Kleibergen-Paap rk Wald F statistic (IV F-stat)		114.925		
p-value		0		
Stock-Yogo test at 10%		16.38		
Anderson-Rubin test p-value		0.030		
Wu-Hausman test p-value		0.074		
AR (1) p-value	0			
AR (2) p-value	0.541			
Hansen test p-value	0.285	0		

Robust t-statistics in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

engagement, and improve ESG performance, thereby enhancing corporate legitimacy and decreasing the incentives to greenwash. These opposing influences likely neutralize each other, resulting in the observed non-significant linear relationship. *Dual* is significantly positively correlated with *GW*, which confirms H6.

In addition, the adjusted R² increases from 0.424 in Model 1 to 0.430 in Model 2, and further to 0.443 in the final Model 3, suggesting the addition of a powerful set of controls. Moreover, in Model 2, which excluded financial and regional economic variables, *Mshare* and *Size* had significant effects on *GW*. However, when such variables were included in Model 3, these significant effects disappeared. This suggests that while *Mshare* and *Size* influence *GW*, their impacts may depend on the company’s financial conditions or regional economic variables, or they may be overshadowed by these factors.

Applying Smith (2016)’s transformation procedure, we translate the statistically significant coefficients from Model 3 into economically meaningful magnitudes: a one-standard-deviation increase in the proportion of female directors corresponds to a

9.8% change in greenwashing intensity, whereas analogous increases in independent-director proportion, average board tenure, board-meeting frequency, and CEO duality yield changes of 18.4%, 37.6%, 11.1%, and 9.6%, respectively; collectively, these estimates highlight board tenure and director independence as the most economically consequential governance levers, with female representation, meeting frequency, and CEO duality exerting more moderate—though still non-trivial—effects.

Endogeneity tests. This study employed multiple methods to address endogeneity issues. First, we employ the two-step system generalized method of moments (GMM) (Blundell and Bond, 1998), incorporating lagged values of the dependent variable (*L.GW*) into the regression equation to capture potential dynamic effects, and using appropriate instrumental variables to effectively address reverse causality and potential endogeneity issues. The results in Column 1 of Table 4 confirm the robustness of our GMM model, with a significant AR (1) p-value and non-significant AR (2) and Hansen test p-values. Importantly, the GMM regression results align with the main regression results.

Second, we conducted an endogeneity test on gender diversity, which is a focal point and critical issue in the relationship between corporate governance and ESG (or CSR). The primary concern was endogeneity, owing to reverse causality. Female board members may impact ESG disclosure (Bravo and Reguera-Alvarado 2019). However, companies with better ESG reporting practices may also attract female directors. To address this endogeneity issue, we adopted the two-stage least squares regression (2SLS) method with instrumental variables. Drawing on Abdelkader et al. (2024), we employ an instrumental variable constructed as the industry-level average of board gender diversity (*Female_mean*), calculated by excluding the focal firm. Table 4 presents 2SLS results. Column 2 (first stage) shows that *Female_mean* is strongly and negatively associated with *Female* ($\beta = -0.595, p < 0.01$), satisfying the instrument-relevance criterion. Instrument strength and model identification are further corroborated by several diagnostics: the first-stage F-statistic is 114.93 (well above the conventional threshold of 10), the Kleibergen–Paap rk LM test rejects under-identification ($p < 0.01$), the Kleibergen–Paap rk Wald F statistic indicates no weak-instrument problem (10% maximal IV size < 16.38), and the Anderson–Rubin Wald test confirms the joint significance of the endogenous regressors ($p < 0.05$), further attesting to the robustness of the instrumental-variable specification (Venturelli et al. 2024). Moreover, the Wu–Hausman test detects endogeneity ($p < 0.10$), justifying the use of an instrumental-variable approach. Column 3 (second stage) reveals that *Female*, *Indep*, and *Tenure* significantly reduce greenwashing, whereas *Meeting* and *Dual* significantly increase it—findings that align with the baseline OLS estimates.

Another concern is endogeneity due to sample selection bias, as female directors potentially self-select board positions in firms with higher social responsibility (Alkhawaja et al. 2023). To address this issue, we employed propensity score matching (PSM). In our PSM design, firms with at least one female director (*Female* > 0) constitute the treatment group (Issa 2023). For each treated observation, we select its three nearest neighbors from the pool of untreated firms, using the remaining five independent variables and all control variables as matching covariates. Consequently, apart from the presence of female directors, the treatment and control groups are comparable across all observable characteristics. The matching procedure yields 5,596 treated and 3,688 control observations. The maximum standardized bias among the covariates is 3.2%, well below the recommended 5% threshold (Konadu et al. 2022), indicating

Table 5 Robustness test.

	1	2	3	4	5
Symbol	IV-replace	DV-replace GW2	DV-replace GW3	Cluster- provincial	FE-Industry × Year
Female		-0.281** (-2.14)	-0.031** (-2.19)	-0.265** (-2.30)	-0.260** (-2.18)
Indep		-1.054*** (-3.29)	-0.093*** (-2.59)	-1.110*** (-3.75)	-1.105*** (-3.73)
Tenure		-0.007*** (-8.37)	-0.001*** (-7.97)	-0.007*** (-9.79)	-0.007*** (-8.77)
Meeting		0.007* (1.85)	0.001*** (3.08)	0.008** (2.43)	0.007** (2.17)
Bsize		0.000 (0.03)	0.000 (0.39)	0.001 (0.06)	0.001 (0.05)
female	-0.066** (-2.30)				
indep	-0.410*** (-3.64)				
tenure	-0.328*** (-9.21)				
meeting	0.099*** (2.79)				
bsize	0.461*** (4.30)				
Dual	0.079** (2.05)	0.073* (1.68)	0.009* (1.93)	0.080** (2.14)	0.073* (1.86)
Control	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	No
Industry	Yes	Yes	Yes	Yes	No
Industry × Year	No	No	No	No	Yes
Constant	0.318 (0.64)	0.640 (1.22)	-0.665*** (-10.84)	0.444 (0.83)	0.397 (0.83)
Observations	12,395	10,763	12,395	12,395	12,284
R-squared	0.448	0.449	0.564	0.448	0.500

Robust t-statistics in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

satisfactory balance. Table A3 reports the balance statistics which confirm that PSM effectively mitigates pre-matching group differences. Table A4 presents the average treatment effect on the treated (ATT). Before matching, the greenwashing gap between the two groups is 0.107; after matching, it reverses to -0.073. Treated firms thus show a stronger suppression of greenwashing than control firms, and the difference is statistically significant. Re-estimating the baseline regression on the matched sample (Table 4, column 4) yields results consistent with the full-sample analysis, reinforcing the conclusion that female directors significantly curb greenwashing.

Robustness tests. Besides addressing endogeneity issues, we conducted robustness tests with alternative variable specifications. First, following Ma et al. (2024) and Agarwalla and Sahu (2024), we applied logarithmic transformations to all independent variables except CEO duality. Specifically, we used the natural logarithms of female board members plus one, the number of independent directors, average tenure in months, annual meeting frequency, and total board size, denoted respectively as *female*, *indep*, *tenure*, *meeting*, and *bsize*. The results reported in Table 5, column 1, largely confirm our main findings, with one notable exception: board size shows a statistically significant positive association with GW, which supports H5a and aligns with Tagliatalata et al. (2024). This pattern—insignificant in levels but significant and positive in logs—provides strong suggestive evidence of an inverted U-shaped relation, consistent with increasing marginal agency costs as boards expand.

Second, this study considers the impact of the time lag between ESG disclosure and actual performance on the measurement of greenwashing. After a company discloses its ESG commitments or plans in a given year, the corresponding performance improvements often do not materialize until the following year or later. Using the difference between disclosure and performance in the same year may therefore lead to misclassifying some firms as engaging in greenwashing. To address this issue, the study lags the performance variable by one year and measures greenwashing as the difference between ESG disclosure in the current year and ESG performance in the following year (GW2). The results reported in Table 5, column 2, are consistent with those of the main regression. Third, following Jiang et al. (2024), we employed an alternative greenwashing measure that applies min-max normalization to scale ESG disclosure and performance scores to [0, 1], recalculating the ESG greenwashing score (GW3) using the following formula. Results using this alternative dependent variable specification (Table 5, column 3) align with our main findings.

$$Greenwashing_{i,t} = \frac{ESG_{dis,i,t} - \min(ESG_{dis})}{\max(ESG_{dis}) - \min(ESG_{dis})} - \frac{ESG_{per,i,t} - \min(ESG_{per})}{\max(ESG_{per}) - \min(ESG_{per})}$$

Finally, we performed robustness checks by (i) clustering standard errors at the provincial level to mitigate potential cross-cluster correlation and (ii) replacing the Industry × Year fixed effects with alternative specifications that more fully capture unobserved heterogeneity and time-varying sectoral shocks (Chen and Dagestani 2023). The results—reported in columns 4 and 5 of Table 5—remain consistent with our baseline estimates.

Table 6 Additional analysis of Meeting.

	1	2	3	4
Symbol	ESG _{dis}	ESG _{dis}	ESG _{per}	ESG _{per}
Meeting	0.103*** (3.12)	0.123** (2.20)	0.007 (0.46)	-0.051 (-1.45)
Meeting ²		-0.001 (-0.42)		0.002* (1.80)
Control	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Constant	-44.295*** (-10.17)	-44.398*** (-10.19)	37.011*** (16.36)	37.308*** (16.48)
Observations	12,395	12,395	12,395	12,395
R-squared	0.640	0.640	0.223	0.224

Robust t-statistics in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Our findings demonstrate robustness across multiple specifications, with the sole exception of the logarithmic board size measure, which yields slightly different results from our main analysis.

Additional analysis. To further investigate the unexpected positive correlation between *Meeting* and *GW*, we conducted supplementary analyses. Following Jiang et al. (2024), we independently regressed *ESG_{dis}* and *ESG_{per}* on meeting frequency, employing both linear and quadratic regression models—including an additional independent variable, *Meeting²*, which represents the squared term of *Meeting*—to capture potential non-linear effects. Based on the existing control variables, we also incorporated other board characteristics (*Female*, *Indep*, *Tenure*, *Bsize*, *Dual*) as control variables into the models. Results reveal a significant positive correlation between *Meeting* and *ESG_{dis}* (Table 6, Column 1), which aligns with previous findings (Anyigbah et al. 2023). However, the quadratic regression results (Table 6, Column 2) indicate that the inverted U-shaped relationship between *Meeting* and *ESG_{dis}* is not significant. Regarding the relationship between *Meeting* and *ESG_{per}*, although the correlation is positive (Table 6, Column 3), the linear relationship lacks statistical significance. Furthermore, the inverted U-shaped relationship is not evident (Table 6, Column 4), as the U-test *p*-value exceeds 0.05. These findings suggest that the relationship between *Meeting* and *ESG_{per}* is relatively weak.

From the FTT perspective, frequent board meetings can intensify the three enabling conditions that foster greenwashing. They heighten legitimacy and rating demands, encouraging boards to use meetings as symbolic displays of environmental commitment—visible activity that satisfies stakeholders without commensurate substance. They also institutionalize proceduralism and operational frictions, expanding the scope for cosmetic disclosure and impression management rather than effective oversight. Finally, the ritual of regular convening, together with voluminous minutes and decks, can function as a moral alibi, allowing directors and managers to rationalize symbolic actions by pointing to process compliance and formal documentation despite limited performance gains.

Thus, from the FTT framework, our findings suggest that frequent board meetings amplify greenwashing risks primarily by creating opportunities for symbolic disclosures and providing rationalization for superficial compliance, without effectively mitigating the underlying pressures or improving actual ESG performance.

Table 7 Heterogeneity analysis: media attention.

	1	2
Symbol	High media attention	Low media attention
Female	-0.380*** (-2.70)	0.032 (0.18)
Indep	-1.295*** (-4.08)	-0.862* (-1.85)
Tenure	-0.007*** (-7.59)	-0.007*** (-5.87)
Meeting	0.009*** (2.61)	-0.001 (-0.15)
Bsize	-0.002 (-0.21)	-0.004 (-0.24)
Dual	0.092** (2.04)	0.034 (0.59)
Control	Yes	Yes
Year	Yes	Yes
Industry	Yes	Yes
Constant	0.648 (1.18)	0.413 (0.59)
Observations	8,814	3,406
R-squared	0.446	0.480

Robust t-statistics in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Heterogeneity analysis. Media attention has two completely different effects on corporate greenwashing behavior. On the one hand, according to the governance hypothesis, media attention can serve as an external governance mechanism that enhances accountability and transparency (Li and Chen 2024). Intense media scrutiny subjects corporate ESG decisions to stricter external oversight, thereby reducing managers’ opportunities to engage in greenwashing. Extensive media coverage enhances information transparency, thus reducing information asymmetry between companies and external stakeholders, and further decreasing the opportunity for greenwashing. On the other hand, according to the pressure hypothesis, media attention imposes legitimacy pressure on managers, forcing them to hastily present a responsible image in order to maintain legitimacy (Ren et al. 2024). This is because media exposure of corporate misconduct can damage a company’s legitimacy, thereby increasing the motivation for firms to adopt greenwashing as a means of legitimacy maintenance. These two opposing perspectives suggest that the heterogeneous effect of media attention on the relationship between board characteristics and greenwashing is an open empirical question worthy of in-depth investigation.

We define media attention as the natural logarithm of one plus the number of company-specific news reports from online media and the Chinese Research Data Services database (Lu et al. 2023). The firms were categorized into high and low media attention groups, using the median as the relevant threshold. The analysis results (Table 7, Column 1 and Column 2) show that in firms with higher media attention, *Female* and *Indep* have a more significant inhibitory effect on *GW*. This indicates that the governance mechanism of media attention played a dominant role in enhancing the supervisory functions of female and independent directors. In addition, this was probably the case because the kinds of directors in question are more sensitive to reputational risks and, under media scrutiny, are less likely to rationalize greenwashing (Fan et al. 2024). *Tenure* shows a significant negative correlation with *GW* in both groups, and the Fisher test further confirms that there is no significant difference between the two groups. *Bsize* does not show a significant relationship with greenwashing in either the high or low media attention groups. These results suggest that the heterogeneous

effects of media attention on board size and tenure are not significant. This may be due to the previously discussed offsetting effects of the governance hypothesis and the pressure hypothesis: media attention both enhances the board's supervisory effectiveness and simultaneously intensifies short-term legitimacy pressure. These opposing forces neutralize each other, resulting in an insignificant net effect. *Meeting* and *Dual* show a more significant promoting effect on greenwashing in firms with high media attention, indicating that the pressure mechanism dominates in these two variables. Frequent meetings lead to a decline in ESG performance and increased legitimacy pressure. Media attention, by exposing the company's poor ESG performance, amplifies external doubts about its fulfillment of responsibilities, thereby further exacerbating the legitimacy pressure it faces. Similarly, CEO duality increases legitimacy pressure, while the high level of media attention focusing on issues such as excessive concentration of corporate power and neglect of stakeholder interests further magnifies the external impact of governance deficiencies, intensifies this pressure, and heightens the motivation for greenwashing.

Conclusions and discussion

Research conclusions. This study employs FTT to examine the relationship between six board governance attributes and corporate greenwashing behavior. Table 8 summarizes the study's main findings, covering hypotheses, hypothesis test results, FTT mechanisms, economic significance, and media-attention heterogeneity.

First, female directors enhance stakeholder engagement, strengthen board oversight, and demonstrate greater sensitivity to unethical practices, thereby reducing pressure, opportunity, and rationalization for greenwashing.

Second, independent directors similarly constrain greenwashing by enhancing managerial oversight, improving stakeholder engagement, and maintaining personal reputational concerns that collectively diminish rationalization tendencies.

Third, extended board tenure enables directors to accumulate valuable experience and skills that both enhance supervisory capacity and reduce information asymmetry between the board and management. This simultaneously decreases opportunities for greenwashing and improves responsiveness to stakeholder demands, alleviating legitimacy pressures that might otherwise drive greenwashing behavior. In addition, the persistent and informed scrutiny from long-tenured directors increases the psychological cost of rationalizing greenwashing, as managers anticipate that any deceptive behavior will be critically assessed by experienced board members.

Fourth, frequent board meetings are positively associated with greenwashing, as they may increase the three components of fraudulent behavior. Heightened legitimacy demands make frequent meetings a symbolic display of environmental commitment, increasing visibility without commensurate substance. The proliferation of meetings entrenches proceduralism and operational frictions, creating opportunities for impression management and cosmetic disclosure rather than effective oversight. The ritual of regular convening and the accompanying volume of minutes and decks also furnish a moral alibi, enabling managers and directors to rationalize symbolic actions by pointing to process compliance despite limited performance gains. Although such meetings may respond to stakeholder, regulatory, or rating pressures, these forces often elicit symbolic management rather than operational change. Consequently, a mechanism intended to strengthen ESG oversight can paradoxically become a vehicle for impression management, expanding formal compliance while

allowing substantive performance to lag and widening the disclosure–performance gap.

Fifth, our analysis reveals no significant linear relationship between board size and greenwashing, potentially due to two countervailing mechanisms. While increased board size may create more opportunities for greenwashing, it may simultaneously reduce pressure. According to FTT, assuming relatively constant rationalization conditions, greenwashing behavior emerges from the confluence of pressure and opportunity. Smaller boards maintain stronger supervisory effectiveness that curtails greenwashing opportunities, while larger boards face reduced external legitimacy pressures that diminish greenwashing motivations. Consequently, moderate-sized boards may present the optimal conditions—sufficient pressure and opportunity—for greenwashing behavior to manifest. Based on these findings, we hypothesize a non-linear, inverted U-shaped relationship between board size and ESG greenwashing, providing a promising direction for future research.

Sixth, CEO duality creates ideal conditions for greenwashing by concentrating power that weakens oversight, neglecting stakeholder interests thereby increasing legitimacy pressures, and enabling rationalization of deceptive ESG practices as strategically necessary.

In addition, the analysis of economic significance shows that board tenure and director independence have the greatest economic impact, while female board representation, meeting frequency, and CEO duality exhibit smaller but still meaningful effects.

Finally, our study identifies heterogeneous effects of media attention on the relationship between board characteristics and greenwashing, revealing distinct governance and pressure mechanisms. As shown in Fig. 2, for female directors and independent directors, increased media attention primarily manifests through governance mechanisms—enhancing their supervisory effectiveness, reducing opportunities for greenwashing, and consequently further suppressing such behavior. Conversely, for meeting frequency and CEO duality, media attention predominantly operates through pressure mechanisms by intensifying legitimacy pressures, thereby increasing motivations for greenwashing. These findings highlight the dual nature of media attention as a double-edged sword in corporate governance contexts, simultaneously strengthening monitoring in some governance dimensions while exacerbating pressure-induced greenwashing tendencies in others.

Cross-National Comparison and Contextualization. The findings of this study regarding the suppressive effects of female directors and independent directors on greenwashing are consistent with evidence from both developed and emerging markets. Studies covering 23 developed markets and samples from the United States and Europe report similar negative associations (Gull et al. 2023a; Keresztúri et al. 2025; Pisano et al. 2025). In emerging markets, results from Malaysia and India likewise support the constraining role of female and independent directors (Gidage et al. 2024; Lee et al. 2025). This consistency suggests that the mechanism whereby diversity and independence enhance monitoring quality and reduce symbolic disclosure demonstrates strong cross-country robustness and generalizability. However, differences in measurement specifications and institutional contexts may shape the magnitude and form of these effects. For female directors, European research indicates that measurement by absolute number may yield an inverted U-shaped relationship (Fleitas-Castillo et al. 2025), whereas measurement by proportion produces a linear negative correlation (Cotugno et al. 2025).

Table 8 Summary of Findings.

Board characteristic	Hypotheses	Test results	FTT Component	Theoretical Mechanism	Economic significance	Media attention moderation effect
1 Female	Negative or Positive	Negative	Pressure (↓)	Increase board sensitivity to stakeholder welfare concerns; provide legitimacy resources Strengthen board oversight greater moral sensitivity Leverage networks and expertise to facilitate substantive sustainability improvements Strengthen board oversight; reduce information asymmetry High reputational stakes and stricter ethical norms	9.8%	Positive
2 Indep	Negative	Accept	Opportunity (↓) Rationalization (↓) Pressure (↓)	As symbolic strategy to signal environmental commitment without substantive action Signal bureaucratic inefficiency and diluted oversight The ritual of frequent meetings supplies a moral alibi	18.4%	Positive
3 Tenure	Negative	Accept	Opportunity (↓) Rationalization (↓) Pressure (↓) Opportunity (↓)	knowledge improve responsiveness to stakeholders Strengthen board oversight; reduce information asymmetry	37.6%	Non-significant
4 Meeting	Negative or Positive	Positive	Pressure (↑) Opportunity (↑) Rationalization (↑)	Low cohesion delays responses to stakeholders Coordination frictions, free-riding, diluted accountability impair monitoring bystander effect	11.1%	Positive
5 Bsize	Positive or Negative	Reject	Agency Theory Pressure (↑) Opportunity (↑) Rationalization (↑) Pressure (↑) Opportunity (↓)		-	Non-significant

Board characteristic	Hypotheses	Test results	FTT Component	Theoretical Mechanism	Economic significance	Media attention moderation effect
Dual	Positive	Accept	Pressure (↑) Opportunity (↑)	Broader stakeholder ties/expertise help coordinate needs Enhanced monitoring capacity and resource depth improve governance effectiveness Legitimacy conflicts intensify Weakens supervisory effectiveness; reduces information transparency Frame deception as "strategic necessity"	9.6%	Positive
6			Rationalization (↑)	Opportunity (↓)		

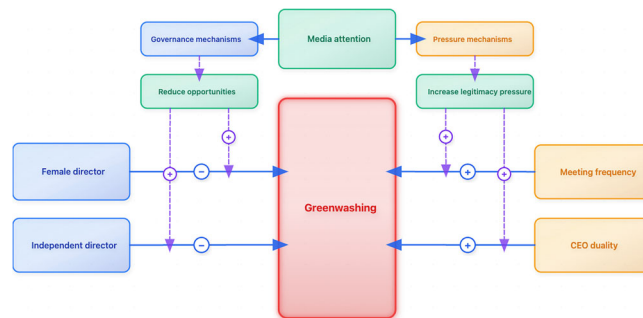


Fig. 2 The Heterogeneity of media attention: governance and pressure mechanisms.

Regarding director tenure, direct cross-country evidence remains limited. This study finds that longer tenure is associated with lower greenwashing, potentially reflecting stronger firm-specific knowledge and long-term governance orientation that reinforce oversight of substantive performance. Nevertheless, in different markets, tenure may also entail countervailing entrenchment effects that attenuate monitoring effectiveness (Remo-Diez et al. 2025). External generalization of these findings should therefore be assessed cautiously in light of local director selection and replacement systems.

Meeting frequency shows a positive association with greenwashing in this study, suggesting that intensive meetings may reflect procedural burdens or crisis-driven responses rather than effective governance. Direct cross-country evidence on meeting frequency and greenwashing remains scarce, and meeting practices may be heavily influenced by global financial crises, regulatory compliance cycles, disclosure requirements, cultural norms, the progress and quality of information shared during meetings, and directors' diligence (Abdullah et al. 2024; Baselga-Pascual et al. 2018; Jarboui et al. 2023). Therefore, this relationship is likely context-dependent.

Board size shows no significant effect in this study, yet Indian samples reveal a positive association between size and greenwashing (Gidage et al. 2024). This divergence suggests that coordination costs and monitoring dilution in oversized boards may be more pronounced in certain markets.

Regarding CEO duality, this study finds that role separation is associated with lower greenwashing, consistent with checks-and-balances logic. However, a global multi-country study using a gap index constructed from green communication and green practices reports that duality narrows the "say-do" gap (Tagliatalata et al. 2024). This discrepancy likely originates from measurement differences, warranting caution in cross-country generalization. Future research should employ multiple greenwashing measures concurrently to enhance comparability.

In summary, the directional effects of female directors and independent directors exhibit strong cross-country consistency and theoretical interpretability, whereas meeting frequency, board size, and CEO duality appear more context-dependent due to institutional, cultural, and measurement influences. This study situates the Chinese evidence within the broader international literature, helping to distinguish generalizable governance mechanisms from those requiring localized interpretation.

Theoretical implications. This study provides several significant contributions to the existing literature. First, drawing on FTT, it systematically examines how multiple dimensions of board characteristics influence firms' propensity to engage in ESG greenwashing, rather than focusing on isolated attributes. To the best of our knowledge, we are among the first to incorporate

board tenure and board meeting frequency into the analysis of how board characteristics relate to ESG greenwashing. Notably, our findings suggest that frequent board meetings may paradoxically facilitate greenwashing, thereby providing new evidence supporting the argument that excessive meeting frequency can indicate operational inefficiencies and underperformance.

Second, although this paper is based on the context of China's A-share market, comparisons with developed economies and other emerging markets indicate several governance regularities that are generalizable: board independence and gender diversity, as a threefold carrier of "external legitimacy—monitoring intensity—ethical capital," exhibit cross-country robustness in curbing greenwashing; by contrast, structural factors such as meeting frequency, size, and CEO duality are more readily moderated by institutional arrangements, board role norms, and differences in greenwashing measurement. Accordingly, governance theory should balance "generalizable mechanisms" and "contextual institutional boundaries," and advocate clarifying measurement consistency and institutional moderation paths in cross-country research.

Third, this study contributes to the literature by not only identifying statistically significant relationships between board governance characteristics and greenwashing intensity, but also by translating these estimates into economically meaningful magnitudes. This approach allows for a practical comparison of governance levers, revealing that average board tenure and director independence exert the largest economic effects, while variables such as female board representation, meeting frequency, and CEO duality also show non-trivial influence. Such translation enhances the managerial relevance of our findings and provides actionable insights for policymakers and boards aiming to curb ESG greenwashing.

Fourth, anchored again in the fraud triangle framework, this study proposes and empirically explores how media attention exerts heterogeneous influences on the relationship between board characteristics and ESG greenwashing through two distinct mechanisms: governance and pressure. Specifically, intense media scrutiny can serve both as an external governance mechanism by enhancing oversight and alleviating information asymmetry, thereby reducing opportunities for greenwashing, and as a source of legitimacy pressure that compels managers to superficially demonstrate ESG commitment. These nuanced insights underscore the critical importance of incorporating external environmental governance factors, particularly media attention, into analyses of internal board governance mechanisms.

Managerial implications. This study provides important managerial implications for companies and media. For corporations, our findings provide empirically-grounded guidance for mitigating ESG greenwashing through optimized board structures. Specifically, organizations should prioritize board gender diversity and independence, extend director tenure, reduce board meeting frequency, and avoid CEO duality to effectively curb greenwashing. Enterprises should also place importance on enhancing the ESG literacy and capability of board members by providing professional training to improve directors' awareness and understanding of ESG issues, thereby strengthening their ability to evaluate and supervise corporate ESG practices. In particular, special attention should be given to cultivating the ESG expertise of independent and female directors to fully leverage their positive role in preventing ESG greenwashing. Meanwhile, companies may consider appointing directors with professional ESG backgrounds to bring expert perspectives and knowledge to the board. In addition, when managing external media relations, companies should take into account the structural characteristics

of their boards, proactively improve governance standards, and avoid relying solely on external oversight to curb greenwashing. They should also be cautious of the potential for strategic greenwashing under media pressure. Specifically, when the proportion of female and independent directors is low and internal oversight is weak, firms may moderately rely on external media scrutiny as a supplementary mechanism to suppress greenwashing behavior. Conversely, when high board meeting frequency or CEO duality leads to reduced ESG performance, firms should be vigilant in managing the risk of increased legitimacy pressure caused by excessive media attention, in order to avoid falling into a vicious cycle of "symbolic compliance and substantive greenwashing." Such differentiated media relation management strategies can help companies, based on their governance characteristics, achieve substantial improvements in ESG performance.

The media should recognize its dual role in supervising corporate ESG practices—as both a watchdog and a potential source of pressure. Based on this understanding, media organizations should strengthen their professional oversight function by cultivating specialized ESG assessment teams, establishing scientific evaluation indicator systems, and improving the professionalism and depth of their reporting. At the same time, the media should adopt differentiated oversight strategies: intensifying scrutiny over companies with low board gender diversity or insufficient board independence, and paying special attention to the consistency between ESG disclosures and actual practices in companies with frequent board meetings or CEO duality. Moreover, the media should focus on uncovering the substantive aspects of ESG rather than merely its formalities. It should avoid relying solely on the volume of disclosures or superficial indicators as evaluation standards and instead conduct in-depth investigations into companies' actual ESG practices. Finally, the media should establish effective information-sharing mechanisms with regulatory agencies, maintaining its independence while forming a collaborative oversight force. Through balanced reporting and sustained attention, the media can guide companies to focus on the long-term, substantive outcomes of ESG rather than short-term, media-driven symbolic compliance, thereby better fulfilling its positive role in promoting genuine corporate social responsibility.

From all perspectives, sound internal governance and active external oversight must work in tandem to ensure the authenticity and credibility of ESG practices. Corporate boards are the first line of defense against greenwashing—through diverse, independent, and efficient governance, they can align a company's ESG communications with its actual actions. The media, positioned at the forefront of public information disclosure, amplifies the impact of governance quality and pressure, necessitating differentiated strategies based on board composition to maximize its value in deterring greenwashing behavior.

Limitations and future research. This study has several limitations. First, it focuses on Chinese listed companies and provides important evidence for understanding the emerging-market context, but it lacks comparisons with other countries under a unified specification, which limits the ability to distinguish a "China-specific pattern" from "generalizable regularities." Although we have conducted cross-national literature comparisons and contextualized discussions, future research should adopt multi-country comparative designs and carry out analyses within a unified greenwashing measurement framework to systematically assess the impact of institutional and cultural differences on the effectiveness of board governance. Second, while we

examined six key board characteristics and their heterogeneity in media attention and institutional-investor oversight, other internal governance mechanisms, such as ESG committees, as well as other external governance factors, such as institutional-investor oversight and analyst coverage, warrant further investigation to provide a more comprehensive understanding of how governance mitigates greenwashing. Third, our model tests main effects of board characteristics without examining potential interactions among FTT components. The theory suggests that fraud risk peaks when pressure, opportunity, and rationalization converge, implying that governance mechanisms may work synergistically rather than independently. Future research should explore these interaction effects to better understand under what conditions board characteristics are most effective in constraining greenwashing. Fourth, while we address the endogeneity of gender diversity using targeted tests (SLS and PSM), similar concerns may apply to other board attributes. The system GMM specification offers a general correction for dynamic endogeneity and unobserved heterogeneity, but the absence of strong external instruments for each attribute remains a limitation. Future research should identify exogenous shocks or institutional variations serving as valid instruments for these characteristics to strengthen causal inference. Finally, we measure greenwashing as the difference between ESG disclosure and ESG performance. However, this difference-based methodology presumes a linear, causal link between disclosure and performance—an assumption that may not hold given industry-specific reporting conventions and potential rating biases. It also treats greenwashing as a static, one-dimensional construct. By centering solely on greenwashing, the study overlooks the broader spectrum of ESG signaling, which includes both overstatement (greenwashing) and understatement (greenhushing). Moreover, relying on Bloomberg's disclosure-oriented ESG score and Huazheng's performance-oriented ESG rating introduces potential rater-model biases—including differences in materiality weighting, disclosure vs. outcome emphasis, data coverage and imputation, China-specific regulatory alignment, normalization/scaling, and update/lag structures—that may influence our results and limit external validity. Future research should adopt alternative rating frameworks, draw on multiple data sources, and employ innovative measures of greenwashing so that both greenwashing and greenhushing can be examined concurrently, yielding a more nuanced picture of corporate ESG disclosure strategies and their underlying drivers.

Data availability

All data supporting this study are included in the article and its supplementary materials.

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Author contributions

Jingzhuo Yu: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, and writing—original draft. Yong-Sik Hwang: conceptualization, writing—review and editing, supervision, resources and project administration, data curation.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was not required as the study did not involve human participants.

Informed consent

Informed consent was not required as the study did not involve human participants.

Additional information

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Correspondence and requests for materials should be addressed to Yong-Sik Hwang.

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