

## The Limits of Carbon Reporting

### Abstract

This study advances a behavioral perspective of carbonwashing by conceptualizing it as a satisficing carbon reporting strategy shaped by CEO duality. We argue that CEO duality intensifies organizational identification, creating strong impetus for dual CEOs to demonstrate commitment to sustainability norms and secure legitimacy while avoiding the economic and operational costs associated with full transparency. We further theorize that sustainability-specific sensegiving mechanisms, including sustainability-linked compensation and committee, reorient dual CEOs' identification toward substantive environmental action over symbolic reporting, thereby attenuating carbonwashing. Using a sample of 3,218 firm-year observations across 644 firms in 31 countries while addressing endogeneity concerns, we find that CEO duality amplifies carbonwashing, but this effect is significantly attenuated by sustainability-linked bonus and sustainability committee.

**Keywords.** Carbonwashing, Satisficing, Organizational identification, Sustainability-specific sensegiving, CEO duality.

## The Limits of Carbon Reporting

### INTRODUCTION

Environmental sustainability has surged to the forefront of corporate priorities in the twenty-first century, propelled by the 2015 Paris Agreement's call for firms to pursue carbon neutrality amid mounting social pressure. Over 20,000 companies across 50 industries have publicly pledged net-zero emissions in support of this treaty (Global Climate Action NAZCA, 2025). However, these voluntary commitments are shrouded in carbonwashing—selective reporting of tangible action and commitments to carbon reduction (In & Schumacher, 2021), attracting scholarly attention to two crucial questions: What drives carbonwashing, and what mechanisms can counteract it.

Prior research portrays CEOs as agency-theoretic opportunists, shirking sustainability for self-interest (Jensen & Meckling, 1976; Muller & Kolk, 2010; Sauerwald & Su, 2019; Gull et al., 2023), and highlights inadequate monitoring as a core driver (Delmas & Burbano, 2011) and regulation as the remedy (Marquis & Qian, 2014; Marquis et al., 2016; Short & Toffel, 2010). However, this view remains incomplete, as it overlooks the inherent tension CEOs face in reconciling environmental sustainability with organizational imperatives of profitability—a deeply institutionalized economic value. CEOs confront a fundamental dilemma: balancing the social imperative of long-term environmental responsibility against economic priorities, while climate concerns remain socially constructed issues extending beyond operational considerations (Delmas & Burbano, 2011). As organizational men in leadership roles, CEOs "devote themselves to the organization's goals far beyond the devotion required to avoid detection of their shirking" (Simon, 1947, p. 44), thereby embodying stewardship (Davis, Schoorman, & Donaldson, 1997) and satisfying stakeholder expectations (Boyd, 1995; Finkelstein & Hambrick, 1990; Mackey, 2008). These competing perspectives underscore the necessity of moving beyond the prevailing "bad guy" portrayal of CEOs toward investigating the structural and organizational factors that drive carbonwashing and the mechanisms through which such inclinations can be constrained.

Drawing on behavioral logics (Cyert & March, 1963; Davis et al., 1997), we recast carbonwashing as a satisficing carbon reporting strategy: selective carbon reporting that minimally satisfies stakeholder expectations while circumventing substantive environmental. Carbonwashing thus contrasts sharply with comprehensive carbon reporting—a genuinely socially satisficing strategy involving systematic measurement, verification, and disclosure of emissions, processes foundational to effective carbon management and continuous performance improvement (Luo, Zhang, & Zheng, 2025). High-quality carbon reporting requires directing capital toward firms with credible low-carbon transition plans and aligning financial flows with climate mitigation objectives (Hu & Borjigin, 2025). However, carbon reporting constitutes an inherently ill-structured and ambiguous action—one imposing prohibitive costs and implementation risks while simultaneously enhancing transparency and regulatory compliance (Ascui & Lovell, 2011). In this regard, carbonwashing enables firms to project their commitment to sustainability values and secure social legitimacy while circumventing the substantive costs and organizational disruption associated with transparent carbon reporting.

We integrate the behavioral perspectives of stewardship (Davis, Schoorman, & Donaldson, 1997) and organizational sensemaking (Weick, 1995) to theorize that CEO duality amplifies carbonwashing. By concentrating responsibility and decision authority (Finkelstein & D'Aveni, 1994), duality intensifies CEOs' organizational identification (Simon, 1947), channeling their sensemaking toward profitability goals and predisposing them to sacrifice for social legitimacy rather than pursue substantive environmental change. Duality simultaneously places CEOs in strategic and stewardship roles (Davis et al., 1997), compelling them to balance outward displays of environmental responsibility with internal pressures to preserve profitability. Given that carbon reporting is inherently ambiguous and ill-structured (Ascui & Lovell, 2011), CEO duality amplifies CEOs' tendency to construe it as a competing, lower-priority concern relative to profitability, leading them to resolve this tension through satisficing disclosure that selectively reports environmental commitments to secure social legitimacy.

We develop a contingent framework theorizing organizational mechanisms that counteract carbonwashing tendencies amplified by CEO duality. Specifically, we propose two structural design features—(i) sustainability-linked bonuses and (ii) sustainability committees—as sustainability-specific sensegiving devices that constrain CEO satisficing in carbon disclosure. These mechanisms shape CEO sensemaking by institutionalizing sustainability as a core organizational identity and creating performance imperatives that position environmental accountability as intrinsic to firm purpose rather than regulatory compliance, thereby redirecting disclosure practices from symbolic toward substantive environmental commitment. Using a sample of 3,218 firm-year observations across 644 firms in 31 countries and addressing endogeneity, we find that CEO duality amplifies carbonwashing—but this effect is significantly attenuated by sustainability-linked bonus and sustainability committee.

Our study advances corporate sustainability research in several important ways. Whereas prior work emphasizes regulatory approaches to curbing carbonwashing (e.g., Delmas & Burbano, 2011; Marquis & Qian, 2014; Marquis et al., 2016; Short & Toffel, 2010), we introduce a behavioral perspective that conceptualizes carbonwashing as a satisficing reporting strategy shaped by CEO duality—a core structural factor of a firm’s administration. We argue that CEO duality heightens organizational identification with the organization, creating a strong impetus for CEOs to demonstrate stewardship in sustainability commitments. We further theorize that sustainability-specific sensegiving mechanisms—sustainability-linked incentives and committees—as sensegiving mechanisms that reorient dual CEOs’ identification with substantive action over symbolic reporting, dampening their tendency for carbonwashing. In so doing, this work complements governance-centric accounts (Aguilera et al., 2021; Walls & Berrone, 2017) while extending organization design theory (Puranam, 2017) by illuminating how authority structures interact with sustainability-specific design interventions. Further, our study also departs from prior studies that focus on CEO duality’s financial implications (Baliga et al., 1996; Boyd, 1995; Finkelstein & D’Aveni, 1994; Mackey, 2008) by revealing duality as a carbonwashing antecedent and identifying organizational sensegiving mechanisms that mitigate this tendency.

These insights offer actionable implications for board governance and policy design in advancing authentic corporate sustainability. These insights offer actionable implications for managerial practice and policy aimed at fostering authentic corporate sustainability.

## THEORY DEVELOPMENT

### **Carbonwashing**

Carbonwashing refers to a carbon reporting strategy in which firms cultivate the appearance of strong climate responsibility - through pledges, narratives, visuals, and policies - without undertaking commensurate, technically substantive measures to reduce emissions. In the post-Paris era of heightened climate concerns, carbon reporting has become a salient corporate activity as firms face growing expectations to measure and disclose GHG emissions and comply with global climate action. Thousands of companies now voluntarily participate in standards and initiatives such as the Carbon Reporting Project (CDP), the Science Based Targets initiative (SBTi), and UN-affiliated campaigns like Race to Zero, which set minimum criteria for net-zero commitments and annual progress reporting (CDP, 2024; UNFCCC, 2024). While these initiatives have institutionalized expectations for target-setting and reporting (e.g., pledge–plan–proceed–publish), firms are increasingly accused of adopting symbolic policies decoupled from core technical operations - what Meyer and Rowan (1977) describe as “myth and ceremony” - to secure legitimacy rather than deliver operational change (Westphal & Park, 2020). Such practices are characterized as symbolic because they emphasize measurable direct emissions using methodological choices that favor lower reported figures while excluding value-chain impacts (Kim & Lyon, 2015) or frontload future decarbonization commitments without substantiated implementation pathways (Fiss & Zajac, 2006). Although prior research often attributes these behaviors to agency problems, it overlooks a critical point: carbon reporting is epistemologically ill-structured, lacking the defining characteristics of mainstream organizational problems (Newell & Simon, 1972).

### **Carbon Reporting as an Ill-Structured Problem and Carbonwashing as a Satisficing Strategy**

Carbon reporting is an inherently complex accounting activity marked by institutional ambiguity, technical intricacy and methodological indeterminacy (Ascui & Lovell, 2011; Cho et al., 2015; Laine, 2024). It requires systematic tracking of emissions across dispersed operations and value chains, demanding coordination with internal and external actors to collect primary data, standardize conversions, and conduct verification (Gipper et al., 2025) . Firms often perceive carbon reporting as an externally imposed requirement with ambiguous organizational consequences (March & Simon, 1958; Brightman, 1978). This ambiguity is amplified by regulatory uncertainty, as exemplified by ongoing debates and implementation challenges surrounding the EU Corporate Sustainability Reporting Directive (CSRD) (Tetzlaff, 2025), as well as competing disclosure frameworks (such as the GHG Protocol, TCFD, ESRS and ISO 14064)<sup>1</sup> that diverge on materiality thresholds, emission factors, organizational boundaries (operational control, equity share, financial control), and value-chain allocation methods. Such methodological pluralism heightens uncertainty, forcing firms to navigate paradoxical tensions: transparency versus competitive sensitivity, comparability versus contextual accuracy, and comprehensive reporting versus operational feasibility (Hahn et al., 2014; Smith & Lewis, 2011).

Moreover, the practical barriers to such comprehensiveness, including data availability constraints, supply-chain complexity, and capability limitations, exacerbate reporting challenges for firms (Wright et al., 2017). In particular, the causal links between organizational actions and climate outcomes are temporally distant and causally diffuse, making it difficult for firms to establish clear connections between reporting and organizational performance (Konlechner et al., 2019). Firms must contend with suppliers' varying willingness and capacity to provide emissions data (Seuring & Müller, 2008; Parmigiani & Rivera-Santos, 2015), reconcile inconsistent data quality and methodological choices across multiple parties (Matisoff et al., 2013), and manage exponential growth in data demands as value chains expand (Beske et al.,

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<sup>1</sup> These frameworks include the Greenhouse Gas Protocol (international measurement standard developed by WRI and WBCSD), TCFD (Task Force on Climate-related Financial Disclosures; investor-focused framework), the European Sustainability Reporting Standards, and ISO 14064 (international verification standard). Each framework specifies different organizational boundaries, emission factor methodologies, and scope definitions.

2014) and coordinate verification procedures across geographically dispersed and functionally diverse operations (Simnett et al., 2009). Further, the requisite investments in measurement system development, specialized personnel training, supplier coordination infrastructure, and third-party verification can be prohibitively costly (Delmas & Montes-Sancho, 2010; Hoffman & Woody, 2008). These costs compound multiplicatively, as expanding measurement scope exponentially increases data management complexity and verification burden while exceeding most organizations' resource capacity (Simon, 1977; Cyert & March, 1963).

Given the ill-structured nature of carbon reporting, executives therefore face difficulty justifying exhaustive, verification-intensive reporting when sustainability is perceived as an extramural, socially mandated value misaligned with core economic priorities. At the same time, institutional pressures - regulatory mandates, media scrutiny, and activist interventions - compel firms to demonstrate environmental stewardship and secure legitimacy without jeopardizing market position, capital access, or reputation (Marquis et al., 2016). Thus, caught between these opposing forces, executives adopt a satisficing strategy by engaging in less resource-intensive, symbolically adequate carbon reporting. This approach enables firms to indicate commitment to sustainability norms and secure legitimacy while avoiding the economic and operational costs associated with full transparency.

### **CEO duality and Carbonwashing**

Satisficing actions like carbonwashing manifest when CEOs embrace organizational identification as stewards of firm welfare, forging a profound psychological fusion between personal identity and organizational success that demands balancing economic vitality with social legitimacy imperatives (Finkelstein & D'Aveni, 1994). Such a stewardship mindset induces CEOs' internalization of the firm's enduring interests as their own and compels them to resolve clashing demands through identity-congruent compromises, prioritizing core operational continuity while projecting symbolic environmental virtue to preempt stakeholder sanctions. Such identification renders carbonwashing adaptive rather than opportunistic, as stewards satisfice by enacting minimal reporting that plausibly demonstrate responsibility without imperiling

profitability, establishing a behavioral template that structural conditions like CEO duality can systematically intensify.

CEOs' responsibilities fundamentally encompass the intertwined sensemaking and sensegiving processes (Gioia & Chittipeddi, 1991), positioning them as pivotal interpreters and shapers of organizational reality amid deep equivocality arising from clashing economic imperatives of profit maximization and operational efficiency and burgeoning sustainability logics of stringent carbon regulations and stakeholder activism (Maitlis & Christianson, 2014). Their sensemaking and sensegiving drive satisficing actions by resolving irreducible complexity through plausibility rather than optimality. While sensemaking prompts CEOs to retrospectively bracket equivocal cues into actionable frames that halt exhaustive search and enact "good enough" environments like symbolic carbon pledges, sensegiving disseminates these frames to coordinate collective plausibility, legitimizing boundedly rational choices amid trade-offs (Weick, 1995; Gioia & Chittipeddi, 1991).

This dynamic intensifies markedly under CEO duality, a microstructural design concentrating leadership in one individual, where unified command not only amplifies CEOs' organizational identification but recasts them as archetypal stewards psychologically fused with firm identity and compelled to safeguard both economic vitality and social legitimacy (Finkelstein & D'Aveni, 1994). For dual CEOs, economic priorities constitute professionally institutionalized norms deeply embedded in executive roles, as stewardship theory posits that duality fosters unified command to decisively advance shareholder value and firm performance, outweighing agency risks in contexts demanding leadership coherence (Donaldson & Davis, 1991). In particular, they embrace sensemaking frames that privilege streamlined economic rationality over multifaceted trade-offs, prompting selective enactment of symbolic environments like decoupled carbon reporting that rhetorically gesture virtue while insulating core operations, thus resolving inherent CEO trade-offs with boundedly rational good enough outcomes rather than Pareto-optimal transformations (Crilly et al., 2016). Sensegiving subsequently cascades these reinforced frames downward through authoritative tactics, harnessing stewardship motives to

project external legitimacy without incurring the sunk costs of substantive decarbonization, thereby perpetuating carbonwashing as a resilient path-dependent behavioral equilibrium amid temporal and institutional tensions (Slawinski & Bansal, 2012). Based on this logic, we posit:

***Hypothesis 1: CEO duality will be positively associated with carbonwashing.***

### **The Role of Sustainability-specific Sensegiving Mechanisms**

Although carbon reporting remains inherently ambiguous and ill-structured (Ascui & Lovell, 2011), CEO duality heightens organizational susceptibility to carbonwashing. We theorize in Hypothesis 1 that dual CEOs' pronounced identification with institutionalized profitability norms cultivates satisficing approaches to carbon reporting; however, this inclination can be attenuated through mechanisms that establish organizational sense toward sustainability values and legitimize CEOs' attention to enacting environmental imperatives, including transparent carbon reporting. We examine two such mechanisms: sustainability-linked executive compensation and sustainability committees. Both function as sustainability-specific sensegiving devices that institutionalize sustainability as a constitutive organizational value, thereby rendering environmental commitments coherent within organizational identity while simultaneously constraining executive discretion for selective or expedient disclosure.

#### ***Sustainability-linked bonus***

CEO compensation systems institutionalize conceptions of valued performance, thereby shaping managerial cognition and resource allocation (Finkelstein & Hambrick, 1988). Given the say-on-pay mechanism, CEO compensation represents one of the few corporate decisions where shareholders exercise formalized, substantial influence (Edmans et al., 2023). When sustainability metrics are embedded into CEO compensation contracts, this structure institutionalizes environmental accountability as a core organizational value, creating a compelling impetus for dual CEOs to strengthen their identification with sustainability values and internalize substantive environmental performance as a meaningful organizational goal (Bridoux & Vishwanathan, 2020). By embedding sustainability into compensation, shareholders—as primary stakeholders—legitimize sustainability as a core organizational value rather than a

peripheral moral concern, thereby institutionalizing environmental accountability in dual CEOs' evaluative frames of carbon reporting and encouraging them to integrate financial and societal objectives while providing substance to corporate environmental actions (McGuire et al., 2003; Bridoux & Vishwanathan, 2020).

Empirical evidence supports this logic. Substantive sustainability integration emerges when CEO pay is tied to long-term performance (Flammer & Bansal, 2017; Mahoney & Thorne, 2006) and, more recently, when compensation explicitly incorporates sustainability-related metrics (Flammer et al., 2019; Hong et al., 2016). This pattern parallels the inclusion of other value-relevant, non-financial indicators such as customer satisfaction or product quality in executive compensation (Cohen et al., 2023). By integrating environmental and social criteria into compensation contracts, sustainability-linked pay institutionalizes these dimensions as legitimate domains of managerial accountability, thereby reshaping dual CEOs' evaluative frames toward long-term environmental and social performance (Flammer et al., 2019; Tsang et al., 2021). This reframing fosters executives' commitment to substantive environmental investments despite uncertain outcomes, offsetting the satisficing tendency that otherwise permits symbolic action (Berrone & Gomez-Mejia, 2009).

Thus, sustainability-linked bonus serves as a sustainability-oriented sensegiving mechanism that reshapes dual CEOs' evaluative criteria by institutionalizing environmental accountability as a strategic imperative. This compensation alignment enables dual CEOs to reconcile profitability imperatives with climate expectations, attenuating the satisficing tendency that otherwise permits selective carbon disclosure and symbolic environmental commitments.

***Hypothesis 2:*** *The positive association between CEO duality and carbonwashing will be negatively moderated by sustainability bonus.*

### **Sustainability Committee**

Board committees are organizational administrative structures designed to help firms interpret, monitor, and respond to social and political issues arising under institutional pressure (Greening & Gray, 1994). A sustainability committee is one such board-level structure designed to guide and oversee environmental strategy, including the firm's climate policy, GHG reduction targets, and

carbon disclosure initiatives (Peters & Romi, 2014). Its primary function is to elevate carbon-related issues to the apex of organizational decision-making (Cowen et al., 1987).

Empirical evidence demonstrates that sustainability committees positively influence a firm's social and environmental outcomes (Biswas et al., 2018; Dixon-Fowler et al., 2017) and promote more comprehensive climate-related disclosure (Cosma et al., 2022). These committees perform a pivotal sensemaking function: they review environmental policies and practices against stated sustainability commitments, gather and interpret information on climate risks and stakeholder expectations, and participate in the reporting of environmental information (Michelon & Parbonetti, 2012). Moreover, sustainability committees strengthen communication channels with key stakeholders, including investors, employees, and customers (Dixon-Fowler et al., 2017). Through this process, committee members weigh the advantages and disadvantages of decarbonization initiatives, promote investments in feasible emission-reduction projects, and enable the firm to credibly collect, record, and account for GHG emissions (Liao et al., 2015).

Sustainability committee therefore functions as an interpretive system that helps CEOs interpret and prioritize competing external demands and translate complex sustainability challenges into coherent strategic and reporting responses. This aligns with their service and advisory function to the CEO (Johnson et al., 1996), transforming sustainability from an externally imposed norm into an internally understood and actionable organizational value (Amran et al., 2014). In doing so, committees reduce the cognitive complexity surrounding environmental issues, particularly the ambiguous and ill-structured process of carbon reporting, where meanings and expectations are socially constructed and continuously evolving.

This functional capacity of sustainability committee becomes especially critical in firms with CEO duality, where CEOs must interpret carbon reporting while remaining focused on profitability as an institutionalized professional norm. In such contexts, the sustainability committee functions as an administrative sensemaking mechanism that reduces the individual cognitive effort required for interpretation and integration. By organizing, filtering, and framing sustainability information, the committee enhances the salience of carbon reporting while

conserving the CEO's scarce attentional resources. As a result, the presence of a sustainability committee mitigates the satisficing tendency of dual-role CEOs to pursue selective carbon disclosure and symbolic environmental commitments. We thus posit:

**Hypothesis 3:** *The positive association between CEO duality and carbonwashing will be negatively moderated by sustainability committee.*

## METHOD

### Data and sample

The initial sample contained 10,254 firm-year observations based on all firms in carbon intensive industries included in Bloomberg's ES scores database as of January 2022. At the time of data collection, information was available for the period 2015-2020. To build final sample the following observations were dropped from the initial sample: (a) missing firm-year observations for *Carbonwashing* (4043 observations) (b) firm-year observations related to the "silent companies" (Delmas & Burbano, 2011) that provide no carbon-related disclosures (1807 observations) c) observations related to countries without mandatory environmental disclosure policies (576 observations)<sup>2</sup> d) missing firm-year observations for the main variables of interest, i.e. *CEO duality* (43 observations), *Sustainability bonus* (2 observations), (e) missing firm-year observations for firm-level control variables (470 observations). We obtained a final sample of 3219 firm-year observations pertaining to 766 firms headquartered in 34 countries. About 50 percent of the observations in our data belong to companies from the United States (701), followed by China (398) and Japan (338). The three most occupied industry clusters in the sample include basic materials (1157), financial (957), and energy (577).

### Variables

#### **Dependent variable**

Prior literature delivers several approaches to measure *Carbonwashing*, which reflects a discrepancy in a firm's sustainability actions and measured as the gap between revealed

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<sup>2</sup> This approach allowed us to investigate companies facing similar institutional pressures with respect to environmental performance. The countries were identified based on the information provided in the Carrots & Sticks database (Carrots & Sticks, 2024).

sustainability commitments and substantive actions. We measured this using Bloomberg's GHG emission management score reported in its proprietary database for firm environmental and social (ES) scores. Bloomberg employs voluntary disclosures obtained from primary sources, such as sustainability reports, annual filings, proxy statements, corporate governance reports, supplemental releases, and company websites to calculate this score. Their dataset includes both binary qualitative "policy" fields related to symbolic firm performance, as well as binary+ data (with a quantitative element underlying the policy) and quantitative data, which captures substantive performance. Binary fields are assigned a value of 1 if the company discloses on the selected topic and a value of 0 if Bloomberg doesn't find evidence of a certain policy.

The scores are hierarchically structured comprising issues, sub-issues, and fields. GHG Emissions Management issue includes four sub-issues: GHG Emissions, GHG Emissions Policies, GHG Regulation, and GHG Targets, which aggregate associated environmental data fields. At the issue level, Bloomberg reports two types of scores: a performance score and an issue score, both ranging from 0 to 10. The performance score is initially computed as an average of sub-issue scores, considering only disclosed performance. The issue score is calculated in the second step by adjusting the performance score using the disclosure factor, which assesses the disclosure of quantitative and binary+ fields. A company with a perfect performance score (10) based solely on policy-related disclosures (disclosure factor = 0) will receive an issue score of 3. This procedure prevents a perfect "policy" performance score from disclosing only qualitative information. In other words, companies disclosing only policy information and failing to provide sufficient evidence of their outcomes are penalized by adjustments in the issue score.

To measure carbonwashing, we used the difference between the self-reported GHG Emissions Management Performance Score and the Bloomberg-adjusted GHG Emissions Management Issue Score. Consistent with Bloomberg's methodology, it ranges from 0 (no discrepancy between the two scores) to 7 (maximum discrepancy), where a company receives a performance score of 10 but fails to disclose any quantitative data, resulting in an issue score adjustment to 3.

### ***Independent variables***

Hypothesis 1 predicts that CEO duality positively influences a firm's carbonwashing. We operationalized *CEO duality* as a binary variable that equals 1 if the CEO occupies the chairmanship of the firm's board. Such a structure signifies a centralized systems of unity of command at the top, signifying unambiguous decision-making authority and leadership for the CEO (Finkelstein & D'Aveni, 1994; Firstenberg & Malkiel, 1994). The measure is a binary variable derived from Bloomberg's ESG dataset that takes a value of 1 if the company's CEO is also Chairman of the Board, as reported by the company, and 0 otherwise.

Furthermore, our conceptual framework further proposes the role of sustainability-specific sensegiving mechanisms in attenuating carbonwashing in firms with CEO duality structure. Hypothesis 2 posits that sustainability-linked compensation will attenuate the positive effect of CEO duality on carbonwashing. We employed *Sustainability bonus* - a binary variable reported by Bloomberg that takes a value of 1 if the firm has executive compensation that is linked to ESG goals and 0, otherwise (Jain & Zaman, 2020), Second, Hypothesis 3 predicts that the positive impact of a CEO duality on carbonwashing will be attenuated by the presence of sustainability-dedicated board committee at the board level. We used *Sustainability committee* - a binary variable that indicates whether a company has a CSR or sustainability committee at the board level as reported by Bloomberg (Ali Gull et al., 2023).

### ***Control variables***

We controlled for organizational characteristics that may influence firm's tendency for carbonwashing. Specifically, we included the firm's size measured as the natural logarithm of total assets (*Firm size*), return on assets (*ROA*), Tobin's Q ratio (*Qratio*), sales revenue in million (*Sales*), common equity (*Equity*) and leverage measured by total debt to equity ratio (*Leverage*). On one hand, larger and more profitable companies, being more vulnerable to activist and media scrutiny, face heightened risks and costs associated with carbonwashing exposure (Crilly et al., 2012). On the other hand, more profitable firms with larger margins demonstrate greater

resilience in handling fines and dealing with financial setbacks resulting from the legal and reputational consequences of carbonwashing exposure (Delmas & Burbano, 2011).

Moreover, we controlled for various governance factors can curb symbolic environmental practices of firms (Ali Gull et al., 2023; Aguilera, 2023). Specifically, our analysis accounts for *Board oversight* measured by the number of independent directors (Lewis et al., 2014; Desender et al., 2016), *Board diligence* measured by the number of meetings in a given year (Brick & Chidambaran, 2010), *Board tenure* measured by the average tenure of a firm's board members (Huang & Hilary, 2018), and *Women on board* measured by the percentage of female directors (Mui and Hill, 2024).

We also controlled for country-level factors that can correlate with a firm's carbon performance and disclosure. Specifically, we included *GDP per capita* to account for the economic situation in the country of the firm's headquarters. Furthermore, as noted in prior literature, the symbol–substance gap in firms' environmental reporting may result from weak regulations and poor enforcement (Delmas & Burbano, 2011). Hence, we controlled for *Rule of law* for each firm's country of headquarters as reported by World Bank in Worldwide Governance Indicators. This measure captures perceptions of the extent to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (Kaufmann et al., 2011). We additionally controlled for the extent to which civil societies can scrutinize companies (Marquis et al., 2016) and included *Societal oversight* using the Freedom House's Freedom of Expression and Belief score, which accounts for free and independent media, individual's freedom of expression, religious and academic freedom (Freedom House, 2021). Finally, we controlled for the industry effects (*Industry effects*) and temporal aspects (*Year effects*) that can bear on a firm's tendency to engage in carbonwashing. We chose to not include country fixed effects due to multicollinearity with the country-level control variables already included in the models, however our findings are consistent with their inclusion (we report them in sensitivity analysis).

To address the influence of outliers, all continuous independent variables were winsorized at the 1st and 99th percentiles. Additionally, to facilitate interpretation, all continuous variables were standardized using z-scores. Table 1 presents the definitions of all our variables.

\*\*\*Insert Table 1 here\*\*\*

### **Empirical Model**

We test our hypotheses using generalized linear models (GLM) with gamma distribution and log link function. This specification is appropriate given that our dependent variable—carbonwashing—is a continuous, strictly positive measure that is nonnormal (Shapiro-Francia test statistic for normality = 0.83,  $p=0.000$ ) and exhibits right-skewness and high kurtosis (1.82 and 9.18, respectively,  $\chi^2 = 1019.95, p=0.000$ ). Moreover, the Gamma distribution accommodates the heteroskedastic nature and skewed shape of such data, while the log link ensures predicted values remain positive and allows for interpreting effects in terms of proportional (multiplicative) changes. To validate the appropriateness of the distributional assumption, we performed a Modified Park Test (p-value?) (Manning & Mullaly, 2001). We first run direct effect model for Hypothesis 1, followed by two-way interaction models to test Hypotheses 2 and 3:

$$\text{Carbonwashing}_{it} = \beta_0 + \beta_1 \text{CEO duality}_{it} + \beta_2 \text{Sustainability bonus}_{it} + \beta_3 \text{Sustainability committee}_{it} + \beta_4 \text{Controls}_{it} + \sum \beta_j \text{Year}_t + \sum \beta_j \text{Industry}_i + \mu_i \quad (1)$$

$$\text{Carbonwashing}_{it} = \beta_0 + \beta_1 \text{CEO duality}_{it} + \beta_2 \text{CEO duality}_{it} \times \text{Sustainability bonus}_{it} + \beta_3 \text{Sustainability bonus}_{it} + \beta_4 \text{Sustainability committee}_{it} + \beta_3 \text{Controls}_{it} + \sum \beta_j \text{Year}_t + \sum \beta_j \text{Industry}_i + \mu_i \quad (2)$$

$$\text{Carbonwashing}_{it} = \beta_0 + \beta_1 \text{CEO duality}_{it} + \beta_2 \text{CEO duality}_{it} \times \text{Sustainability committee}_{it} + \beta_3 \text{Sustainability committee}_{it} + \beta_4 \text{Sustainability bonus}_{it} + \beta_3 \text{Controls}_{it} + \sum \beta_j \text{Year}_t + \sum \beta_j \text{Industry}_i + \mu_i \quad (3)$$

### **EMPIRICAL FINDINGS**

Table 1 provides descriptive statistics to present the overall characteristics of the sample firms. The mean value for *Carbonwashing* is noted at 1.62. *CEO duality*, *Sustainability bonus*, *Sustainability committee* are noted for 24%, 27% and 41% of firm-year observations, respectively. The sample firms reveal variations in terms of size, financial performance corporate governance practices, as well as institutional and economic development of their country of

headquarters. Table 2 reports the correlation matrix. *Carbonwashing* is positively correlated with *CEO duality* ( $p=0.000$ ) and negatively correlated with *Sustainability bonus* ( $p=0.000$ ) and *Sustainability committee* ( $p=0.000$ ). *Carbonwashing* is 1.60 for a firm with *CEO duality* while it is 1.46 for a similar firm without *CEO duality* (mean difference = 0.14,  $p=0.000$ ). Moreover, in a subsample of firms with *CEO duality* *Carbonwashing* is 44 percent less for firms with a *Sustainability bonus* relative to similar firms without a bonus (1.02 and 1.79,  $p=0.000$ ). Likewise, in a subsample of firms with *CEO duality* *Carbonwashing* is 27 percent less for firms with a *Sustainability Committee* relative to similar firms without a committee (1.02 and 1.79, respectively;  $p=0.000$ ). Together, these univariate statistics provide preliminary support for our proposed hypotheses. Our data also do not suffer from multicollinearity concerns. The mean variance inflation factor (VIF) is 2.41 while the maximum VIF is 4.92, which are below the commonly used threshold of 10 (Neter et al., 1989), suggesting that multicollinearity is not a serious concern in our data.

\*\*\*Insert Tables 1-2 here\*\*\*.

Table 3 reports the GLM estimates for *Carbonwashing*. Model 1 includes the vector of control and moderating variables. Model 2 illustrates the direct effect of *CEO duality*. Models 3-4 illustrate the moderating effect of *Sustainability bonus and committee*. The Wald chi-squared values indicate that models in Table 3 are statistically significant ( $p<0.001$ ). The reported standard errors are robust to heteroskedasticity. The parameter estimate of *CEO duality* in Model 2 is positive and statistically significant ( $\beta = 0.070$ ,  $p=0.003$ ) and offers support to our prediction that CEO duality structure positively influences a firm's tendency for carbonwashing (Hypothesis 1). In particular, the size of the parameter estimate reveals the economic significance of CEO duality in driving carbonwashing. Furthermore, the size of the parameter estimate in Model 2 indicates that *CEO duality* increases *Carbonwashing* by approximately 7 percent ( $(\exp(0.070)-1) \times 100 = 7.25\%$ ), suggesting that *CEO duality* plays a substantial role in driving a firm's tendency for carbonwashing. Model 3 illustrates the interaction effect between *CEO duality* and *Sustainability bonus*. The parameter estimate for the interaction term in Model 3 is negative and

statistically significant ( $\beta = -0.285, p=0.000$ ), strongly supporting our prediction in Hypothesis 2 about the role of sustainability-linked compensation in attenuating the positive influence of CEO duality on carbonwashing. The effect is also economically meaningful and suggests that sustainability bonus can reduce the expected value of carbonwashing for a firm with CEO duality by approximately 25 percent ( $(\exp(-0.287)-1) \times 100 = -24.7\%$ ). Similarly, the parameter estimates for the interaction effect between *CEO duality* and *Sustainability committee* in Model 4 is negative and significant ( $\beta = -0.113, p=0.032$ ), in line with our prediction in Hypothesis 3. Moreover, the parameter estimate highlights the economic significance of sustainability committee as a crucial attention improving mechanism for dual CEO, indicating that carbonwashing tendency of firms with a CEO duality structure diminishes by around 11 percent ( $(\exp(-0.114)-1) \times 100 = -10.7\%$ ) when the CEO is supported by a specialized committee at the board level.

\*\*\*Insert Table 3 here\*\*\*

### **Additional Analyses**

#### **Profitability and carbonwashing: Sensemaking trade-offs in CEO duality structures**

Although the empirical analysis highlights the influence of CEO duality and its interaction with sustainability-specific sensegiving mechanisms on firms' carbonwashing, our theoretical framework assumes that a duality structure exacerbates carbonwashing by orienting CEOs' sensemaking predominantly toward firm profitability and away from inherently ambiguous carbon reporting. Moreover, while our main analysis examines how the interplay between CEO duality and sustainability-specific sensegiving mechanisms shapes carbonwashing, it also raises a related question: whether these mechanisms can recalibrate CEOs' priorities so that firms with CEO duality pursue profitability and sustainability in tandem rather than relegating carbon reporting to a secondary or discretionary concern. We explored these aspects using seemingly unrelated regressions (SUR) and jointly estimated profitability – measured as return on equity (ROE) – and carbonwashing.

\*\*\*Insert Table 4 here\*\*\*

Table 4 reports the SUR estimates for profitability and carbonwashing. Model 1 in Table 4 illustrates the direct effect of *CEO duality* on profitability and carbonwashing: the parameter estimates for *CEO duality* are positive and significant for both profitability ( $\beta = 0.658$ ,  $p=0.014$ ) and carbonwashing ( $\beta = 0.130$ ,  $p=0.000$ ). These findings highlight the contrasting outcomes that manifest from CEO stewardship in a duality structure. In particular, our findings provide robust support for the premise that duality pushes CEOs to focus attention on the primary goal of firm performance (e.g., Boyd, 1995), while simultaneously exacerbating their tendency to engage in carbonwashing in order to create a favorable perception of their firms' environmental commitment.

Interestingly, the coefficients on the interaction terms with sustainability bonus in Model 2 ( $\beta = -1.584$ ,  $p=0.014$ ;  $\beta = -0.361$ ,  $p=0.000$ ) and with sustainability committee in Model 3 ( $\beta = 0.331$ ,  $p=0.555$ ;  $\beta = -0.179$ ,  $p=0.011$ ) suggest that these unique sustainability-specific sensegiving mechanisms influence the positive relationship between CEO duality and profitability in different ways. Specifically, our findings in Model 2 indicate that while a sustainability bonus can effectively mitigate carbonwashing among firms with a duality structure—by encouraging CEOs to prioritize sustainability values—it may unintentionally reduce their focus on the primary goal of economic performance, thereby impairing firm profitability. In contrast, Model 3 reveals that a specialized sustainability committee at the board level can strengthen CEO stewardship in firms operating under a CEO duality structure. In particular, it points that sustainability-specific administrative mechanisms can enable dual CEOs to sustain their attention on improving firms' economic performance, while concurrently addressing sustainability concerns and reducing their propensity for carbonwashing. These results underscore the instrumental role of a sustainability committee in helping CEOs in a duality structure balance attention between sustainability and economic goals.

### **CEO duality and satisficing with(out) survival pressures**

We also examined whether the influence of CEO duality on firms' propensity for satisficing carbon reporting varies contingent on organizational performance context. Specifically, we tested

whether firm size and sales performance, dimensions reflecting core organizational survival and growth imperatives, moderate the relationship between CEO duality and selective carbon disclosure, given that dual CEOs' amplified organizational identification intensifies satisficing logic when performance pressures compete with environmental stewardship obligations. Table 5 illustrates these findings. As illustrated in Model 1 in Table 5, the positive effect of CEO duality on Carbonwashing becomes weaker with increasing firm size ( $\beta = -0.087, p=0.002$ ). The positive effect diminishes by 92 percent for a firm that is one standard deviation above the average firm size while it increases by 106 percent for a similar firm that is one standard deviation below mean firm size. Model 2 shows that CEO duality's positive impact on carbonwashing lessens as sales performance improves ( $\beta = -0.045, p=0.014$ ). Specifically, this effect drops by nearly 58% for firms with sales one standard deviation above average but increases by 50% for those with one standard deviation below. These findings indicate that carbonwashing by firms with CEO duality is influenced by competing demands on CEOs' attention. If growth objectives are already addressed, dual CEOs are less likely to engage in carbonwashing; however, when survival and growth goals gain priority, CEO duality increases carbonwashing as CEOs focus on achieving targets while presenting an environmentally responsible image.

\*\*\*Insert Table 5 here\*\*\*

### **Scrutiny and the contingent effects of sustainability-specific sensegiving mechanisms**

Furthermore, while our framework demonstrates that sustainability-specific sensegiving mechanisms can attenuate dual CEOs' carbonwashing propensities, their effectiveness may critically depend on the monitoring context in which dual CEOs operate. Because CEO duality fosters concentrated authority while simultaneously creating entrenchment risks (Finkelstein & D'Aveni, 1994), the responsiveness of dual CEOs to sustainability-specific sensegiving may hinge on complementary oversight structures. We therefore examine whether the attenuating effects of sustainability bonuses and committees depend on internal and external monitoring mechanisms. Specifically, we focus on board oversight as an internal monitoring structure

(Dalton et al., 1998) and stakeholder/media scrutiny as an external monitoring mechanism (Marquis et al., 2016).

\*\*\*Insert Table 6 here\*\*\*

Table 6 presents results examining how internal and external oversight moderates the attenuating effects of sustainability-specific sensegiving mechanisms on duality-induced carbonwashing. Models 2 and 4 demonstrate that sustainability committees' capacity to offset dual CEOs' carbonwashing propensities contingently depends on the strength of both internal and external monitoring. These findings underscore how complementary oversight reinforces administrative sensegiving by intensifying dual CEOs' organizational identification with sustainability values and undermining satisficing logic. In contrast, Models 1 and 3 reveal that sustainability bonuses exhibit attenuating effects independent of monitoring context, suggesting that incentive-based sensegiving obtains CEOs' internalization of sustainability values rather than requiring external validation.

### **Endogeneity of CEO duality**

While our main analyses strongly support the proposed framework, there remains a risk of endogeneity. In particular, our explanatory variable, *CEO duality*, may be influenced by unobserved factors, leading to potential omitted variable bias since these factors could be correlated with both CEO duality and our outcome variable, *Carbonwashing*. To address these concerns, we implemented a control function approach (Wooldridge, 2015), popularly known as the two-stage residual inclusion (2SRI) procedure (Terza et al., 2008).

The 2SRI involves a first stage regression that estimates the endogenous regressor using an exclusion restriction and includes the first stage residuals as an additional regressor in the regression that estimates the main outcome variable of interest. Moreover, the 2SRI approach is considered appropriate when the endogenous regressor or the dependent variable are non-linear (Terza et al., 2008; Wooldridge, 2014). We estimated a first stage probit model for *CEO duality* using national power distance as an exclusion restriction. Studies have found that national power distance significantly influences the adoption of CEO duality structure in a given country (e.g.,

Krause et al., 2016). Moreover, since our data is a cross-country sample of firms from multiple different countries, power distance is an appropriate exclusion restriction to account for the endogeneity of CEO duality. In particular, power distance qualifies as a robust exclusion restriction as it is positively correlated with *CEO duality* (0.05,  $p=0.007$ ) and uncorrelated with error term of *Carbonwashing* (0.01,  $p=0.491$ ). The parameter estimate of power distance in the first-stage probit regression is positively significant ( $p=0.000$ ) while its F-statistic is 74.12 ( $p=0.000$ ) and higher than the threshold value of 10 (Keane & Neal, 2023). We then re-estimated our main models by including the generalized residuals obtained in the first-stage probit regression (Wooldridge, 2014). Table 9 illustrates these findings, and the results are similar to our primary models. In addition to the 2SRI analyses discussed above, in supplemental analyses we implemented entropy balancing estimators (also PSM and CEM) to provide further evidence for causal influence of CEO duality on carbonwashing.

\*\*\*Insert Table 7 here\*\*\*

## DISCUSSION

This study suggests that carbonwashing is an organizationally satisficing strategy that emerges from the characteristic property of carbon reporting as an extramurally specified ill-structured action. We argue and show that the tendency for carbonwashing is more prevalent among firms with a CEO duality structure. We suggest that duality reinforces the CEO's stewardship identification, fostering a tendency to favor carbonwashing as a means to demonstrate the firm's commitment to sustainability values while employing a satisficing strategy to reconcile the organizational goal of profitability with sustainability demands. However, we identify sustainability bonus and environmental committee as important boundary conditions that strengthen the alignment between steward identity and substantive environmental action. These sustainability-specific organizational mechanisms act as sensegiving structures that bolster the legitimacy of carbon reporting, thereby providing a compelling impetus for dual CEOs to embed sustainability values in decision-making beyond mere symbolic disclosure.

Our study makes several contributions to strategy research on sustainability. First, our study advances a behavioral framework rooted in stewardship and sensemaking perspectives, highlighting that the tendency for carbonwashing is often influenced by the structural aspect of CEO duality. We argue that CEO duality, by intensifying stewardship identification (Davis, Schoorman, & Donaldson, 1997), paradoxically favors symbolic over substantive environmental action because authentic carbon reduction creates irreconcilable tensions with competing legitimate organizational goals of profitability and operational stability (Smith & Lewis, 2011). This satisficing perspective fundamentally reframes carbonwashing: rather than moral hazard, dual-role CEOs rationally navigate paradoxical institutional demands (Smith & Tracey, 2016) by accepting disclosure completeness as sufficient expression of steward obligation—effectively maintaining organizational legitimacy through symbolic conformity (Meyer & Rowan, 1977) while deferring the operational transformation required by authentic carbon commitment.

A satisficing logic of carbonwashing offers a fresh perspective on symbolic versus substantive action (Westphal & Park, 2020): rather than viewing it as deliberate communication strategy, our study reveals that dual CEOs with heightened stewardship identification favor carbon washing as sufficient environmental stewardship without compromising economic priorities (Weick, 1995; Davis, Schoorman, & Donaldson, 1997). Through this sensemaking process, what appears as symbolic management becomes an identity-reinforcing mechanism rooted in stewardship logic—dual CEOs rationally navigate unresolvable tensions between economic and environmental demands by accepting carbon reporting as a sufficient expression of steward identity, thereby reframing the disclosure-performance gap as organizationally justified rather than personally deceptive (Pratt & Rafaeli, 1997).

Our findings suggest that dual CEOs' carbonwashing tendency can be attenuated through sustainability-specific mechanisms that justify substantive carbon reporting as a legitimate organizational action. Sustainability bonus functions as incentive-based sensegiving mechanism that embeds comprehensive carbon reporting into dual CEOs' cognitive frames, aligning their organizational identification with sustainability values as a core fiduciary responsibility and

offsetting satisficing logic that otherwise permits selective reporting (Flammer, Hong, & Minor, 2019; Luo & Tang, 2021). In contrast, sustainability committee functions as an administrative sensegiving structure that confers organizational legitimacy to incorporate environmental accountability into dual CEOs' interpretive frames. By enacting sensegiving through sustained deliberation and rigorous interrogation of sustainability claims, sustainability committee play a pivotal role in constructing a shared organizational reality in which comprehensive disclosure constitutes a non-negotiable strategic responsibility rather than peripheral compliance, thereby dampening dual CEOs' carbonwashing propensities (Maitlis, 2005; Rodrigue, Magnan, & Boulianne, 2013).

Our findings carry significant managerial and policy implications. For shareholders and boards, sustainability-specific mechanisms—particularly sustainability committee and carbon-linked compensation—can offset dual CEOs' satisficing carbon reporting by reframing environmental accountability as a core fiduciary responsibility aligned with organizational identification, thus preserving concentrated leadership efficiency while channeling dual CEOs toward substantive carbon stewardship. For policymakers, regulatory frameworks should mandate or incentivize sustainability-specific governance structures rather than relying solely on disclosure standards, given that these mechanisms directly address the cognitive frames through which dual CEOs interpret environmental obligations. Thus, policy interventions targeting the structural conditions shaping CEO sensemaking offer a tractable pathway for mitigating duality-induced carbonwashing while preserving leadership efficiency.

Although our analysis advances understanding of how sustainability-specific mechanisms attenuate dual CEOs' carbonwashing propensities, several limitations warrant acknowledgment. First, these mechanisms may represent a transitional equilibrium rather than permanent institutional embedding (Bromley & Powell, 2012), as carbonwashing may resurface in mutated forms beyond our six-year observational window. Second, our measure operationalizes carbonwashing through selective disclosure across emission scopes, yet other manifestations such as supply chain boundary manipulation or offsetting misrepresentation remain unmeasured

(In & Schumacher, 2021). Finally, our structural perspective does not account for CEO psychological heterogeneity (e.g., Chen, Crossland, & Luo, 2015), as well as generalist versus specialist CEOs' differential susceptibility to satisficing logic (e.g., Chen et al., 2021; Custódio, Ferreira, & Matos, 2013), which may moderate the effectiveness of governance interventions on outcomes like carbon reporting. Future research integrating upper echelon cognition with structural sensegiving mechanisms could elucidate how CEO profiles shape intervention outcomes.

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**Table 1. Descriptive Statistics<sup>a</sup>**

<b>Variable</b>	<b>Mean</b>	<b>Standard deviation</b>	<b>Min</b>	<b>Max</b>
Carbonwashing	1.50	0.88	0	2.56
CEO duality	0.24	0.43	0	1
Sustainability bonus	0.27	0.44	0	1
Sustainability committee	0.41	0.49	0	1
Firm size	9.02	1.34	3.82	12.92
ROA	3.12	7.45	-90.51	58.35
Qratio	1.34	0.71	0.39	10.50
Sales	9960.56	28248.90	0	427,493
Equity	7039.60	15730.68	-3667.01	194,356
Leverage	0.98	2.68	-69.53	75.41
Board oversight	60.44	23.29	0	100
Board diligence	9.65	5.41	0	107
Board tenure	6.20	3.14	0.50	22.79
Women on board	18.26	13.54	0	75
GDP per capita	1560.81	10225.86	1.16	185358.40
Rule of law	11.20	4.44	2	16
Societal oversight	12.87	4.57	1	16

<sup>a</sup>N=3218

**Table 2. Correlation Matrix<sup>a</sup>**

Variable																	
1 Carbonwashing	1																
2 CEO duality	<b>0.06</b>	1															
3 Sustainability bonus	<b>-0.21</b>	-0.02	1														
4 Sustainability committee	<b>-0.16</b>	<b>-0.09</b>	<b>0.33</b>	1													
5 Firm size	<b>-0.09</b>	<b>0.10</b>	<b>0.11</b>	<b>0.04</b>	1												
6 ROA	<b>0.06</b>	0.02	<b>-0.09</b>	<b>-0.05</b>	-0.01	1											
7 Qratio	0.03	0.00	0.00	<b>0.05</b>	<b>-0.23</b>	<b>0.27</b>	1										
8 Sales	<b>-0.06</b>	<b>0.05</b>	<b>0.07</b>	<b>0.14</b>	<b>0.50</b>	0.00	<b>-0.08</b>	1									
9 Equity	<b>-0.08</b>	<b>0.07</b>	<b>0.13</b>	<b>0.15</b>	<b>0.57</b>	0.00	<b>-0.09</b>	<b>0.85</b>	1								
10 Leverage	0.01	-0.02	-0.02	-0.02	<b>0.07</b>	<b>-0.06</b>	-0.03	-0.01	-0.03	1							
11 Board oversight	<b>-0.26</b>	-0.02	<b>0.39</b>	<b>0.24</b>	<b>-0.04</b>	<b>-0.10</b>	<b>0.11</b>	<b>-0.04</b>	<b>0.04</b>	-0.02	1						
12 Board diligence	<b>0.05</b>	0.03	<b>-0.08</b>	<b>-0.05</b>	<b>0.05</b>	<b>-0.04</b>	<b>-0.11</b>	0.03	0.01	0.00	<b>-0.16</b>	1					
13 Board tenure	<b>-0.08</b>	<b>0.05</b>	<b>0.06</b>	-0.01	<b>-0.06</b>	0.01	<b>0.14</b>	<b>-0.13</b>	<b>-0.10</b>	0.00	<b>0.17</b>	<b>-0.24</b>	1				
14 Women on board	<b>-0.16</b>	<b>-0.12</b>	<b>0.24</b>	<b>0.20</b>	0.02	0.03	<b>0.07</b>	-0.03	0.02	0.00	<b>0.41</b>	<b>-0.09</b>	<b>0.07</b>	1			
15 GDP per capita	<b>-0.06</b>	<b>-0.04</b>	-0.01	0.00	-0.02	0.02	-0.02	-0.02	-0.01	-0.02	-0.01	0.01	<b>0.05</b>	0.02	1		
16 Rule of law	<b>-0.13</b>	<b>0.07</b>	<b>0.26</b>	<b>0.11</b>	<b>-0.18</b>	<b>-0.06</b>	-0.02	<b>-0.09</b>	<b>-0.07</b>	<b>-0.04</b>	<b>0.34</b>	<b>0.14</b>	0.00	<b>0.27</b>	<b>0.11</b>	1	
17 Societal oversight	<b>-0.18</b>	<b>0.12</b>	<b>0.31</b>	<b>0.18</b>	<b>-0.18</b>	<b>-0.06</b>	<b>0.06</b>	<b>-0.12</b>	<b>-0.08</b>	-0.02	<b>0.47</b>	<b>0.06</b>	<b>0.12</b>	<b>0.28</b>	<b>0.07</b>	<b>0.89</b>	1

<sup>a</sup>N=3218.  $p \leq 0.05$  in bold.

**Table 3. GLM Estimates for Carbonwashing**

Variables	Model 1	Model 2	Model 3	Model 4
CEO duality		0.070*** (0.024)	0.141*** (0.026)	0.110*** (0.028)
CEO dualityXSustainability bonus			-0.285*** (0.060)	
CEO dualityXSustainability committee				-0.114** (0.052)
Sustainability bonus	-0.166*** (0.030)	-0.159*** (0.031)	-0.101*** (0.033)	-0.159*** (0.031)
Sustainability committee	-0.097*** (0.024)	-0.089*** (0.024)	-0.093*** (0.024)	-0.065** (0.027)
Firm size	-0.036* (0.021)	-0.041* (0.021)	-0.041* (0.021)	-0.040* (0.021)
ROA	0.022 (0.015)	0.022 (0.015)	0.021 (0.015)	0.022 (0.015)
Qratio	0.009 (0.041)	0.008 (0.041)	0.019 (0.041)	0.016 (0.041)
Sales	0.004 (0.014)	0.004 (0.014)	0.005 (0.014)	0.005 (0.014)
Equity	-0.138** (0.058)	-0.140** (0.058)	-0.133** (0.058)	-0.137** (0.058)
Leverage	0.004 (0.012)	0.004 (0.012)	0.004 (0.012)	0.005 (0.012)
Board oversight	-0.070*** (0.013)	-0.068*** (0.013)	-0.061*** (0.013)	-0.070*** (0.013)
Boad diligence	0.000 (0.017)	-0.001 (0.017)	-0.004 (0.017)	-0.000 (0.017)
Board tenure	-0.010 (0.012)	-0.011 (0.012)	-0.007 (0.012)	-0.012 (0.012)
Women on board	-0.020* (0.012)	-0.017 (0.012)	-0.015 (0.012)	-0.015 (0.012)
GDP per capita	-0.046*** (0.011)	-0.045*** (0.011)	-0.045*** (0.011)	-0.044*** (0.011)
Rule of law	0.008 (0.026)	0.013 (0.026)	0.009 (0.026)	0.009 (0.026)
Societal oversight	-0.048* (0.025)	-0.059** (0.026)	-0.061** (0.026)	-0.056** (0.026)
Industry effects <sup>a</sup>	66.67***	65.79***	69.24***	62.69***
Year effects <sup>a</sup>	2.41	2.60	2.12	2.46
Intercept <sup>a</sup>	0.499*** (0.033)	0.469*** (0.034)	0.457*** (0.034)	0.457*** (0.035)
Log-likelihood	-4446.14	-4444.82	-4440.67	-4444.00
Wald $\chi^2$	406.41***	418.81***	454.21***	434.85***

Notes. N=3218. Clustered robust standard errors in parentheses. <sup>a</sup> $\chi^2$  values for joint significance of fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

**Table 4. SUR Estimates for Profitability and Carbonwashing**

Variables	Model 1		Model 2		Model 3	
	Profitability	Carbonwashing	Profitability	Carbonwashing	Profitability	Carbonwashing
CEO duality	0.658** (0.267)	0.130*** (0.035)	1.063*** (0.303)	0.223*** (0.042)	0.541* (0.325)	0.194*** (0.044)
CEO duality XSustainability bonus			-1.584** (0.647)	-0.361*** (0.073)		
CEO duality XSustainability committee					0.331 (0.561)	-0.180** (0.070)
Sustainability bonus	0.649* (0.363)	-0.235*** (0.041)	0.989** (0.405)	-0.157*** (0.045)	0.646* (0.363)	-0.234*** (0.041)
Sustainability committee	-0.181 (0.293)	-0.134*** (0.033)	-0.194 (0.293)	-0.137*** (0.033)	-0.252 (0.332)	-0.095*** (0.037)
Firm size	1.718*** (0.420)	-0.040 (0.032)	1.715*** (0.419)	-0.041 (0.032)	1.717*** (0.419)	-0.039 (0.032)
ROA	16.037*** (0.286)	0.036* (0.021)	16.036*** (0.286)	0.036* (0.021)	16.035*** (0.287)	0.037* (0.021)
Qratio	2.283*** (0.583)	0.029 (0.063)	2.354*** (0.583)	0.045 (0.062)	2.267*** (0.580)	0.038 (0.063)
Sales	1.233*** (0.177)	-0.015 (0.018)	1.237*** (0.176)	-0.014 (0.017)	1.229*** (0.177)	-0.013 (0.018)
Equity	-4.338*** (0.961)	-0.158** (0.077)	-4.261*** (0.957)	-0.140* (0.077)	-4.346*** (0.962)	-0.154** (0.076)
Leverage	2.247*** (0.431)	-0.006 (0.019)	2.244*** (0.431)	-0.006 (0.019)	2.244*** (0.432)	-0.004 (0.019)
Board oversight	0.820*** (0.158)	-0.111*** (0.019)	0.856*** (0.158)	-0.103*** (0.019)	0.824*** (0.157)	-0.113*** (0.019)
Board diligence	0.482* (0.251)	-0.007 (0.025)	0.463* (0.252)	-0.011 (0.025)	0.481* (0.251)	-0.006 (0.025)
Board tenure	0.433*** (0.148)	-0.014 (0.018)	0.452*** (0.148)	-0.009 (0.018)	0.434*** (0.148)	-0.015 (0.018)
Women on board	-0.322** (0.133)	-0.025 (0.017)	-0.319** (0.133)	-0.024 (0.017)	-0.328** (0.133)	-0.022 (0.017)
GDP per capita	0.012 (0.044)	-0.049*** (0.007)	0.015 (0.045)	-0.049*** (0.006)	0.012 (0.044)	-0.050*** (0.007)
Rule of law	0.255 (0.296)	0.022 (0.036)	0.226 (0.297)	0.016 (0.036)	0.262 (0.297)	0.018 (0.036)
Societal oversight	-1.106*** (0.299)	-0.078** (0.036)	-1.110*** (0.298)	-0.079** (0.036)	-1.111*** (0.299)	-0.076** (0.036)
Industry effects <sup>a</sup>	117.76***	117.76***	119.90***	119.90***	115.32***	115.32***
Year effects <sup>a</sup>	25.27***	25.27***	25.10***	25.10***	25.04***	25.04***
Intercept	7.097*** (0.473)	1.644*** (0.050)	7.016*** (0.478)	1.625*** (0.051)	7.132*** (0.476)	1.624*** (0.051)
R-squared	0.791	0.136	0.791	0.141	0.791	0.138

Log-likelihood	-14526	-14526	-14514	-14514	-14523	-14523
Wald $\chi^2$	5019.87***	5019.87***	5107.43***	5107.43***	5035.43***	5035.43***

Notes. N=3218. Clustered robust standard errors in parentheses. <sup>a</sup> $\chi^2$  values for joint significance of fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

**Table 5. Estimates for the Interaction of CEO duality with Firm Size and Sales**

Variables	Model 1	Model 2
CEO dualityXFirm size	-0.087*** (0.029)	
CEO dualityXSales		-0.045** (0.018)
CEO duality	0.095*** (0.024)	0.080*** (0.024)
Sustainability bonus	-0.159*** (0.031)	-0.160*** (0.031)
Sustainability committee	-0.085*** (0.024)	-0.087*** (0.024)
Firm size	-0.031 (0.022)	-0.044** (0.021)
ROA	0.021 (0.015)	0.022 (0.015)
Qratio	0.015 (0.041)	0.006 (0.041)
Sales	0.005 (0.014)	0.022 (0.016)
Equity	-0.122** (0.059)	-0.143** (0.058)
Leverage	0.005 (0.012)	0.004 (0.012)
Board oversight	-0.066*** (0.013)	-0.069*** (0.013)
Board diligence	0.000 (0.017)	-0.002 (0.017)
Board tenure	-0.007 (0.012)	-0.010 (0.012)
Women on board	-0.015 (0.012)	-0.015 (0.012)
GDP per capita	-0.044*** (0.011)	-0.045*** (0.011)
Rule of law	0.009 (0.026)	0.009 (0.026)
Societal oversight	-0.057** (0.026)	-0.055** (0.026)
Industry effects <sup>a</sup>	65.81***	64.81***
Year effects <sup>a</sup>	2.28	2.59
Intercept	0.466*** (0.034)	0.466*** (0.034)
Log-likelihood	-4443.45	-4443.86

Wald  $\chi^2$  439.51\*\*\* 428.74\*\*\*

Notes. N=3218. Clustered robust standard errors in parentheses.  ${}^a\chi^2$  values for joint significance of fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

**Table 6. Three-way Interaction Effects of CEO duality with Board and Societal Oversight**

Variables	Model 1	Model 2	Model 3	Model 4
CEO dualityXBonusXBoard oversight	-0.076 (0.085)			
CEO dualityXCommitteeXBoard oversight		-0.130*** (0.047)		
CEO dualityXBonusXSocial oversight			-0.146 (0.214)	
CEO dualityXCommitteeXSocial oversight				-0.208*** (0.076)
CEO duality	0.136*** (0.030)	0.109*** (0.030)	0.141*** (0.026)	0.112*** (0.028)
CEO dualityXSustainability bonus	-0.209*** (0.081)		-0.219* (0.125)	
CEO dualityXSustainability committee		-0.082 (0.052)		-0.063 (0.056)
Sustainability bonus	-0.114*** (0.035)	-0.163*** (0.031)	-0.085* (0.046)	-0.164*** (0.031)
Sustaiability committee	-0.096*** (0.024)	-0.078*** (0.027)	-0.091*** (0.024)	-0.065** (0.027)
Firm size	-0.039** (0.019)	-0.036* (0.019)	-0.038** (0.019)	-0.038** (0.019)
ROA	0.020 (0.014)	0.020 (0.014)	0.021 (0.014)	0.022 (0.014)
Qratio	0.025 (0.041)	0.031 (0.041)	0.020 (0.041)	0.024 (0.041)
Sales	0.006 (0.014)	0.006 (0.014)	0.006 (0.014)	0.006 (0.014)
Equity	-0.139*** (0.053)	-0.142*** (0.053)	-0.141*** (0.053)	-0.141*** (0.053)
Leverage	0.002 (0.009)	0.002 (0.008)	0.002 (0.009)	0.002 (0.009)
Board oversight	-0.059*** (0.017)	-0.074*** (0.018)	-0.059*** (0.013)	-0.069*** (0.013)
Board diligence	-0.005 (0.017)	-0.006 (0.017)	-0.003 (0.017)	-0.004 (0.017)
Board tenure	-0.006 (0.012)	-0.009 (0.012)	-0.005 (0.012)	-0.010 (0.012)
Women on board	-0.016 (0.012)	-0.016 (0.012)	-0.016 (0.012)	-0.017 (0.012)
GDP per capita	-0.045*** (0.011)	-0.044*** (0.011)	-0.045*** (0.011)	-0.045*** (0.011)
Rule of law	0.004	0.003	0.007	0.012

Social oversight	(0.027)	(0.027)	(0.026)	(0.026)
CEO dualityXBoard oversight	-0.057** (0.026)	-0.054** (0.026)	-0.064** (0.026)	-0.071*** (0.027)
Sustainability bonusXBoard oversight	-0.015 (0.027)	-0.015 (0.028)		
CEO dualityXSustainability committee	0.024 (0.037)			
Sustainability committeeXBoard oversight	0.024 (0.037)	0.061** (0.027)		
CEO dualityXSocial oversight			0.032 (0.023)	0.033 (0.024)
Sustainability bonusXSocial oversight			-0.033 (0.073)	
Sustainability committeeXSocial oversight				0.047** (0.022)
Industry effects <sup>a</sup>	72.31***	63.61***	71.80***	65.83***
Year effects <sup>a</sup>	2.09	2.19	2.12	2.54
Intercept	0.458*** (0.035)	0.456*** (0.035)	0.454*** (0.034)	0.452*** (0.035)
Log-likelihood	-4440	-4442	-4440	-4443
Wald $\chi^2$	474.61***	465.72***	455.82***	451.03***

Notes. N=3218. Clustered robust standard errors in parentheses. <sup>a</sup> $\chi^2$  values for joint significance of fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

**Table 7 Estimates for Two-Stage Residual Inclusion Analysis**

Variables	First-stage	Second-stage GLM for Carbonwashing		
	Model 1	Model 2	Model 3	Model 4
CEO duality		0.060** (0.024)	0.131*** (0.027)	0.099*** (0.028)
CEO dualityXSustainability bonus			-0.281*** (0.059)	
CEO dualityXSustainability committee				-0.109** (0.052)
Sustainability bonus	-0.133* (0.069)	-0.138*** (0.031)	-0.082** (0.034)	-0.138*** (0.031)
Sustainability committee	-0.442*** (0.060)	-0.043 (0.028)	-0.048* (0.028)	-0.021 (0.031)
Firm size	0.262*** (0.057)	-0.076*** (0.024)	-0.075*** (0.024)	-0.074*** (0.024)
ROA	0.063* (0.035)	0.014 (0.015)	0.014 (0.015)	0.014 (0.015)
Qratio	0.160 (0.108)	0.001 (0.041)	0.012 (0.041)	0.009 (0.041)
Sales	-0.007 (0.034)	0.003 (0.014)	0.005 (0.014)	0.004 (0.014)

Equity	0.109 (0.136)	-0.149** (0.058)	-0.141** (0.058)	-0.146** (0.058)
Leverage	-0.018 (0.030)	0.007 (0.012)	0.007 (0.012)	0.007 (0.012)
Board oversight	0.091** (0.037)	-0.061*** (0.014)	-0.055*** (0.014)	-0.063*** (0.014)
Board diligence	0.035 (0.045)	-0.011 (0.018)	-0.014 (0.018)	-0.011 (0.018)
Board tenure	0.127*** (0.032)	-0.027** (0.013)	-0.022* (0.013)	-0.028** (0.013)
Women on board	-0.138*** (0.031)	-0.000 (0.014)	0.001 (0.013)	0.001 (0.014)
GDP per capita	-0.066 (0.048)	-0.034*** (0.011)	-0.035*** (0.011)	-0.034*** (0.011)
Rule of law	-0.109 (0.067)	0.057* (0.030)	0.051* (0.030)	0.053* (0.031)
Societal oversight	0.603*** (0.064)	-0.133*** (0.036)	-0.133*** (0.036)	-0.129*** (0.036)
First-stage residuals		-0.069*** (0.023)	-0.066*** (0.023)	-0.067*** (0.023)
Power distance	0.246*** (0.053)			
Industry effects <sup>a</sup>	60.80***	63.02	67.64***	60.91***
Year effects <sup>a</sup>	3.35	4.07	3.24	3.86
Intercept	-0.210** (0.083)	0.400*** (0.041)	0.391*** (0.041)	0.390*** (0.041)
Log-likelihood	-1567.13	-4443.29	-4439.24	-4442.54
Wald $\chi^2$	349.08***	433.78***	466.17***	449.38***

Notes. N=3218. Clustered robust standard errors in parentheses. <sup>a</sup> $\chi^2$  values for joint significance of fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.