Greenwashing and CEO integrity

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Firms increasingly respond to stakeholders' environmental expectations by engaging in "greenwashing" disclosure activities that aim to mislead information recipients toward adopting overly favorable beliefs about a firm's environmental performance. We investigate whether CEO integrity is associated with a firm's greenwashing and how information recipients assess greenwashing in combination with CEO integrity. The findings suggest that low-integrity CEOs, in contrast to high-integrity CEOs, engage in greenwashing in the form of using voluntary environmental disclosures on Twitter that do not reflect firms' environmental performance. However, information recipients appear to unmask this behavior of low-integrity CEOs. While voluntary environmental disclosures by low-integrity CEOs are associated with a decrease in abnormal returns and environmental ratings, disclosures by high-integrity CEOs are valued by information recipients.

1. INTRODUCTION

The growing environmental awareness increases stakeholders' expectations that firms behave environmentally friendly (BCG 2017; Deloitte 2021). Following Delmas and Burbano (2011), firms increasingly respond to environmental expectations by engaging in "greenwashing" disclosure activities that aim to mislead information recipients into adopting overly favorable beliefs about a firm's environmental performance (Lyon and Montgomery 2015).[1] While literature focuses on firm-related and institutional determinants of greenwashing,[2] management ultimately makes disclosure decisions, with the CEO as the most influential decision maker. However, not all CEOs are willing to engage in misleading disclosure activities, as doing so may violate personal norms. We propose CEO integrity as an important missing driver of a firm's greenwashing activities. To the extent that information recipients such as investors or environmental, social, and governance (ESG)-analysts can assess a CEO's integrity-based inclination to misleading disclosures, the recipients' assessment of a firm's greenwashing activities will reflect the CEO's integrity. We investigate whether CEO integrity is associated with a firm's greenwashing activities and how information recipients assess greenwashing in combination with CEO integrity.

According to upper echelons theory, CEO characteristics matter for CEO style and corporate

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[1] The German firm RWE, for example, focuses its social media disclosure strategy on sustainability, regularly publishing environmental tweets that highlight its commitment to renewable energies and carbon neutrality. However, environmental law charity ClientEarth (2021) included RWE in its "Greenwashing Files", claiming that RWE's sustainability disclosures are designed to mislead the public. Similarly, in 2020, an environmental tweet from Dutch firm Shell – intended to signal Shell's commitment to clean energy and asking for measures that individuals could take to reduce emissions – sparked controversial responses. Many users found the tweet hypocritical, pointing to Shell's role as a major global polluter and criticizing the firm's greenwashing campaigns on social media (The Guardian 2020).

[2] Examples include environmental damage (Marquis et al. 2016), firms' economic performance (Neu et al. 1998), societal and institutional pressures (Cho et al. 2015) such as regulation (Grewal et al. 2022; Mateo-Márquez et al. 2022), or media coverage (Clarkson et al. 2008).

decision-making, as a CEO perceives and evaluates strategic situations through their personal lens (Hambrick 2007; Hambrick and Mason 1984). Literature documents characteristics such as narcissism (Abdel-Meguid et al. 2021), optimism (Davis et al. 2015), and demographics (Bamber et al. 2010) as crucial elements in reporting and disclosure decisions. Following Erhard and Jensen (2014) and Simons (2002), integrity refers to the fit between words and actions, and integrity is a critical determinant of establishing trust and credibility. Thus, third parties expect a high-integrity CEO to make truthful and reliable statements, whereas they perceive a low-integrity CEO as less credible and trust this CEO less. Dikolli et al. (2020), Guiso et al. (2015), and Simons et al. (2015) show that CEO integrity is an important driver of corporate culture and economic outcomes such as firm performance or audit fees.

We start by examining the role of CEO integrity in a firm's greenwashing activities. The firm makes green disclosures to be perceived as environmentally friendly and to receive favorable stakeholder awareness and responses (Marquis et al. 2016). However, misleading environmental disclosures entail the risk that stakeholders perceive environmental disclosures as hypocritical, thus harming the CEO's reputation (Lee et al. 2013). When choosing the firm's voluntary environmental disclosures, the CEO trades off the benefits of a positive corporate environmental image and the cost of a harmed reputation. As integrity represents the fit between words and actions, a high-integrity CEO is arguably unwilling to jeopardize their reputation by engaging in greenwashing activities, whereas a low-integrity CEO is less concerned about putting their reputation at risk through greenwashing. Consequently, we expect CEO integrity to moderate the relation between (actual) environmental performance and voluntary environmental disclosures.[3]

We also examine how information recipients assess a firm's greenwashing activities in combination with CEO integrity. Attribution theory states that an information recipient uses the attributes of the information sender to understand and evaluate the sender's behavior (Fiske and Taylor 1991). Sen et al. (2006) document that stakeholders consider the motives behind a firm's CSR initiative. In this vein, we argue that information recipients such as investors and ESG analysts consider the CEO's integrity when assessing voluntary disclosures of the firm's environmental performance. We expect CEO integrity to moderate the relationship between voluntary environmental disclosures and assessed environmental performance.

To address the research questions, we analyze Twitter disclosures of German companies listed in the HDAX from 2015 to 2020.[4] We use this setting because firms increasingly use Twitter as a voluntary disclosure channel (Alexander and Gentry 2014; Debreceny et al. 2019). Relying on the CSR dictionary by Pencle and Mălăescu (2016), we start by identifying firms' environmental disclosures (i.e., "green tweets") on Twitter. To identify greenwashing activities, we assess whether these environmental disclosures reflect the firm's

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[3] The argument focuses on the CEO, representing all other managers. While we take the perspective that the CEO is in charge of the firm's decision-making, we acknowledge that other managers are involved in the firm's decision-making. However, as the CEO is the most influential decision-maker (Lo and Fu 2016), CEO characteristics are likely to have the greatest influence.

[4] The HDAX is a German stock market index consisting of 99 companies (as of May 2021) of DAX (large-cap), MDAX (mid‑cap), and TecDAX (mid‑cap, technology sector).

environmental performance, proxied by the firm's pollution in terms of carbon emissions. We use hand-collected shareholder letters published in firms' annual reports to proxy CEO integrity by using linguistic analysis. Shareholder letters are a suitable data source to reveal the author's attributes, reflecting the CEO's influence (Amernic et al. 2010; Dikolli et al. 2020). One important dimension of integrity is the individual's truthfulness (Simons 2002; Erhard and Jensen 2014). We build on Hope and Wang (2018) and Larcker and Zakolyukina (2012) to identify truthful and deceptive CEOs.

The evidence suggests that CEO integrity moderates firms' greenwashing on social media. For deceptive CEOs, we find that higher pollution is associated with more green tweets, whereas for truthful CEOs, higher pollution is associated with fewer green tweets. The findings suggest that low-integrity CEOs use voluntary environmental disclosures to distract from adverse environmental performance, whereas high-integrity CEOs appear to refrain from using such a form of impression management.

The evidence also suggests that information recipients see through the CEOs' disclosure behavior. First, we consider investors' assessed environmental performance regarding abnormal returns. For deceptive CEOs, we find that green tweets are associated with a decrease in abnormal returns. An increase in green tweets of one standard deviation involves a reduction in abnormal returns by 20 basis points. In contrast, the association between abnormal returns and green tweets is positive for truthful CEOs. These results suggest that investors consider CEO characteristics when assessing firms' voluntary disclosures on Twitter and thereby unmask low-integrity CEOs' greenwashing attempts. Second, we consider ESG analysts' assessed environmental performance regarding environmental ratings. For deceptive CEOs, we find a negative association between green tweets and firms' environmental rating performance. For truthful CEOs, this relation turns. These observations suggest that ESG analysts consider CEO characteristics, identify firms' greenwashing activities, and evaluate the disclosures accordingly. Overall, these observations suggest that investors and ESG analysts see through low-integrity CEOs' greenwashing activities.

The study contributes to the literature in three ways. First, we add to the literature studying the role of CEO characteristics for disclosure decisions (e.g., Abdel-Meguid et al. 2021; Bamber et al. 2010). We extend this literature by providing evidence that CEO integrity is a relevant managerial characteristic in the context of voluntary environmental disclosures. Second, we add to the literature studying a firm's greenwashing activities (e.g., Cho et al. 2015; Clarkson et al. 2008; Marquis et al. 2016). Prior work focuses on firm and institutional characteristics as drivers of greenwashing. We extend this literature and highlight the relevance of CEO integrity as a manager-related determinant. We find that low-integrity CEOs increase voluntary environmental disclosures when environmental performance is low. Thereby, we also show that the relevance of CEO integrity is not only pertinent for US CEOs (e.g., Dikolli et al. 2020; Guiso et al. 2015) but also applies to German CEOs. Third, we add to the literature on whether information recipients use managerial characteristics to evaluate disclosures (e.g., Loughran and McDonald 2011). For example, Hope and Wang (2018) document that investors consider CEO characteristics when assessing big bath accounting. Showing that investors' and ESG analysts' assessments of environmental disclosures on social media are moderated by CEO integrity, we provide complementary evidence for

information recipients' capabilities to infer and act on managerial characteristics.

2. PRIOR LITERATURE AND HYPOTHESIS DEVELOPMENT

2.1 Greenwashing
Following Lyon and Montgomery (2015), greenwashing refers to disclosure activities that aim to mislead information recipients into adopting overly favorable beliefs about a firm's environmental performance. Cho and Patten (2007) use socio-political theories to argue that greenwashing results from a firm's need for legitimacy, as the firm must abide by the rules and values of society to maintain its legitimacy. If the firm does not fulfill society's expectations (e.g., concerning environmental performance), its legitimacy is threatened (Ashforth and Gibbs 1990; Milne and Patten 2002). Cho et al. (2010) argue that the firm adjusts its disclosure strategy to maintain or even improve stakeholders' perceptions of the firm. Consistently, Merkl-Davies and Brennan (2007) and Hopwood (2009) suggest that voluntary disclosure of environmental performance is a means to change information recipients' perceptions of the firm's legitimacy.

Empirical studies document determinants of firms' greenwashing. Firm-related drivers include firms' adverse environmental performance in terms of environmental damage (Marquis et al. 2016) or ESG scores (Huang and Lu 2022). Cho et al. (2015) and Marquis et al. (2016) find that greenwashing increases with societal and institutional pressures such as adverse media coverage. Grewal et al. (2022) and Mateo-Márquez et al. (2022) document that regulatory requirements can mitigate greenwashing. While literature focuses on firm-related and institutional determinants, little is known about the role of management characteristics for a firm's greenwashing.

We focus on the CEO's influence on a firm's greenwashing. Following Hambrick and Mason (1984), Hambrick (2007), and Lo and Fu (2016), the CEO is the most influential decision-maker in a firm and thus crucial to corporate strategy, including corporate disclosures. Specifically, the literature highlights the relevance of CEO characteristics for environmental decision-making. For example, Zhi (2021) documents a positive association between CEOs' preference for nature and firms' actions to mitigate global warming. While we take the perspective that the CEO is in charge of the firm's decision-making, including the firm's disclosure decisions, we acknowledge that other managers are involved in decision-making. However, as the CEO is the most influential decision-maker, the CEO's characteristics likely have the greatest influence on the firm's disclosure decisions.

Greenwashing entails benefits and costs for a CEO. Kimbrough et al. (2022) document that credible voluntary ESG disclosures reduce information asymmetries. Balluchi et al. (2020) and Luo and Bhattacharya (2006) provide evidence that favorable information on corporate social and environmental responsibility influences stakeholders' purchasing, employment, and investment intentions. Following green disclosures, the firm is perceived as environmentally friendly, receives favorable stakeholder awareness, and improves financial performance (Marquis et al. 2016). To the extent that CSR contracting is present, the firm's assessed environmental performance is associated directly with the CEO's compensation

(Flammer et al. 2019).[5] Thus, the CEO benefits from the variable pay associated with improved financial or environmental performance as well as any improvements in the firm's reputation.

However, vague or empty CSR communication can give stakeholders the impression of hypocrisy (Lyon and Montgomery 2013; Wagner et al. 2009). If stakeholders perceive environmental disclosures as hypocritical, the CEO's reputation is likely to be harmed (Lee et al. 2013).

2.2 CEO integrity

Upper-echelons theory suggests that management characteristics are essential for management style and corporate decision-making, with the CEO as the most influential decision-maker. The literature documents the relevance of CEO characteristics and emotions for corporate disclosure activities, including attributes such as overconfidence, optimism, or narcissism (e.g., Davis et al. 2015; Libby and Rennekamp 2011; Marquez-Illescas et al. 2019); demographic characteristics; personal background; and sentiment (e.g., Abdel-Meguid et al. 2021; Bamber et al. 2010; Chen et al. 2021; Davis et al. 2015; Ge et al. 2011; Lopatta et al. 2022).

Erhard and Jensen (2014) and Guiso et al. (2015) consider the CEO's integrity as one of the most important assets of the firm. A key dimension of integrity is the individual's truthfulness.[6] Simons (2002, p.19) describes high integrity as an "alignment between an actor's words and deeds," i.e., a high fit between words and actions. For either past or planned actions, respectively, the words of a high-integrity individual are consistent with those actions (Erhard and Jensen 2014). Following Patelli and Pedrini (2015), firm leaders are responsible for creating an environment characterized by integrity and a lack of unethical practices. Accordingly, CEO integrity is an important driver of corporate culture and diverse economic outcomes, including firm performance or audit fees (Dikolli et al. 2020; Guiso et al. 2015; Simons et al. 2015).

2.3 Hypotheses development

First, we investigate whether CEO integrity is associated with a firm's greenwashing. Greenwashing is reflected in the discrepancy between environmental disclosures and (actual) environmental performance, i.e., in environmental disclosures that do not reflect environmental performance (Lyon and Montgomery 2015). The CEO uses voluntary environmental disclosures to present the firm as environmentally friendly and to benefit from favorable stakeholder awareness (Marquis et al. 2016). When deciding on the disclosure strategy, the CEO decides whether to use environmental disclosures that do not reflect the firm's environmental performance. CEO integrity represents the extent to which the CEO aligns words and actions. Consequently, a high-integrity CEO is arguably less willing to jeopardize their reputation by engaging in greenwashing, thus refraining from misleading

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[5] For our subsample of DAX40 firms, in 2021, 98% of the firms include sustainability-related targets in CEOs' compensation contracts and 58% of the firms include explicit targets related to carbon emissions. We thank Kai Moßmann for sharing his hand-collected data on CSR compensation.

[6] Integrity is a broad concept that includes facets such as truthfulness, morality, incorruptibility, completeness, or fairness (Dikolli et al. 2020).

environmental disclosures. In contrast, a low-integrity CEO is likely less concerned about putting their reputation at risk through greenwashing. Stated formally: H1—*CEO integrity moderates the relation between environmental performance and voluntary environmental disclosures.*

Second, we investigate how information recipients assess voluntary environmental disclosures in combination with CEO integrity. Attribution theory suggests that an information recipient uses the attributes of the information sender to understand and evaluate the sender's behavior (Fiske and Taylor 1991). Building on attribution theory, Hope and Wang (2018) argue that investors have the capability to infer managers' motives from managers' characteristics and use this information to evaluate disclosures accordingly. Hope and Wang (2018) provide evidence that investors change their perception of CEOs' accounting choices depending on whether the investors perceive the CEO to be deceptive. Similarly, Sen et al. (2006) document that stakeholders consider the motives behind a firm's CSR initiative, and Lopatta et al. (2022) document that information recipients incorporate CEOs' specific reporting styles in their evaluation of corporate CSR engagement.

We argue that information recipients use the information on the CEO's characteristics and evaluate the CEO's voluntary environmental disclosures in light of the perceived characteristics. Thus, we expect that information recipients consider the CEO's integrity when assessing the firm's environmental performance based on voluntary environmental disclosures. Stated formally: H2—*CEO integrity moderates the relation between voluntary environmental disclosures and assessed environmental performance.*

3. METHODOLOGY

3.1 Empirical setting
The sample covers voluntary environmental disclosures on Twitter ("green tweets") for German companies listed in the HDAX for fiscal years 2015 to 2020. Twitter allows firms and individuals to create profile sites, post messages (tweets), follow other users, and interact by replying to or liking other tweets. We consider Twitter a natural setting to investigate voluntary environmental disclosures. In Germany, Twitter is not considered an official and mandatory disclosure channel; therefore, its use is largely unregulated. While firms in the US can use social media such as Twitter to disclose key information in compliance with Reg FG, in Germany, firms are prohibited from doing so, suggesting an appropriate setting to investigate voluntary disclosure decisions.[7]

We hand-collected the firms' Twitter usernames. 86% of the HDAX-listed firms have an active Twitter account (as of May 2021), for which we obtain all postings on Twitter through the Academic Twitter API. We exclude tweets that are retweets, replies, promoted tweets, and non-English tweets.

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[7] Due to the different regulatory requirements in Germany and the US, we acknowledge that our findings might not generalize to a US setting.

We hand-collected firms' shareholder letters from firms' annual reports or homepages to assess CEO integrity. CEO information is obtained from *BoardEx*; missing data is hand-collected. Firm fundamentals and market data are obtained from *Thomson Reuters Datastream*.

After matching the data and excluding missing variables, the final sample consists of 1,120 firm-month observations for the analysis of the relation between environmental performance and voluntary environmental disclosures, moderated by CEO integrity (H1), and the analysis of the relationship between voluntary environmental disclosures and rating analysts' assessed environmental performance, moderated by CEO integrity (H2). For the analysis of the relationship between voluntary environmental disclosures and investors' assessed environmental performance, moderated by CEO integrity (H2), the final sample consists of 6,586 firm-day observations. Table 1 reports the sample selection process.

3.2 Measurement of main variables
Voluntary environmental disclosure
In a German setting, firm disclosures on Twitter can be categorized as voluntary disclosures. As such, we collect tweets published on a firm's Twitter profile. The firm's environmental disclosures are then proxied by the number of environmental (green) tweets the firm posts in a given time period on Twitter. To identify *GreenTweets*, we apply Pencle and Mălăescu's (2016) CSR dictionary for a linguistic analysis of the tweets. The dictionary contains wordlists in the dimensions "employee" (319 words), "environment" (451 words), "human rights" (297 words), and "social and community" (361 words). We rely on the environmental dimension, containing words such as "climate," "CO2," "emission," "renewable," and "pollution." Tweets containing at least one environmental term, according to the wordlist, are classified as voluntary environmental disclosures.[8,9]

Environmental performance
Identifying an appropriate measure of environmental performance is challenging, as sustainability performance is a complex, multi-dimensional construct lacking clear standards (Grewal and Serafeim 2020). We capture environmental performance by relying on real effects and use the relative change in a firm's carbon emissions as an inverse proxy for the firm's environmental performance.[10] Carbon emissions, including Scope 1, Scope 2, and

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[8] To ensure the validity of our identification of green tweets, we repeat the analysis using different cut-off levels for the number of environmental terms. The results are largely robust. Appendix B provides details.
[9] We manually review a subsample of green tweets and find that the majority of these tweets do not reflect negative environmental disclosures (e.g., a discussion of a firm's *poor* environmental performance). We also analyze tweets' sentiments. Based on Loughran and McDonald (2011), we calculate a tone measure as the difference between the number of positive and negative words per tweet, normalized by the tweet's length. We find that the green tweets' tone is more positive compared to other tweets. Further, we repeat the analysis of Model (1) only considering green tweets with a non-negative tone. The regression results are reported in Table B.5 and remain qualitatively unchanged. Collectively, the results of these tests support the claim that a CEO uses green tweets to present the firm as environmentally friendly.
[10] We argue that carbon emissions are a sufficiently accurate representation of a firm's actual environmental performance. Of the H-DAX listed firms, in 2020, 79% indicate that they follow the GHG protocol in assessing

Scope 3 emissions, are available from *Datastream*. The pollution rate of change (*Pollution*) is the ratio of the change in carbon emissions (the difference between the current year's carbon emissions and the prior year's carbon emissions) relative to the prior year's carbon emissions. We use the rate of change to account for firm-specific differences in the level of emissions. With respect to Hypothesis 1, we expect that low-integrity CEOs facing a positive change in carbon emissions increase their voluntary environmental disclosures.[11]

Assessed environmental performance
We use two measures to capture information recipients' assessment of a firm's environmental disclosures. First, we investigate investor reactions and, as an immediate investor response, calculate short-term cumulative abnormal returns over a three-day window, $AR_{d,d+3}$.
Second, we consider ESG analysts' assessment of the firm's environmental disclosures as reflected in analysts' environmental rating evaluation (*RatingPerformance*). We use Refinitiv's Environmental Pillar Score and compute the firm's relative environmental rating performance as the ratio of the change in the firm's environmental rating score and the lagged environmental rating score.

CEO integrity
One key dimension of integrity is the individual's truthfulness (Erhard and Jensen 2014; Simons 2002). To assess the CEO's truthfulness, we rely on linguistic analysis of the CEO's speech in corporate shareholder letters. Literature commonly uses shareholder letters to evaluate individuals' characteristics and tone at the top (Amernic et al. 2010). The letters are signed by the CEO, and research in psychology suggests that written words can be used to identify the author's characteristics at a distance (Pennebaker and Graybeal 2001; Newman et al. 2003). Following Dikolli et al. (2020), shareholder letters reflect the influence of the CEO more than other publicly available sources.

We rely on the approach proposed by Larcker and Zakolyukina (2012) and Hope and Wang (2018) to identify truthful and deceptive CEOs. Larcker and Zakolyukina (2012) build on the Linguistic Inquiry and Word Count (LIWC, Pennebaker et al. 2007) and develop specific wordlists. They document that deceptive CEOs use more references to general knowledge words, more extreme positive emotion words, fewer references to shareholder value words, and fewer anxiety words. Using these categories, we follow Hope and Wang (2018) in their construction of a deception score. The frequency of words negatively associated with deception is multiplied by minus one. For each deception category, we perform a median split and assign a score of two to the upper group and a score of one to the lower group. The aggregated score across all categories reflects Hope and Wang's (2018) deception score. To obtain a binary variable, we perform a tertial split and classify CEOs in the tertial with the highest deception score as deceptive $(TruthfulCEO = 0)$ and CEOs in the tertial with the

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their carbon emissions and 71% of the firms' non-financial disclosures are audited with at least limited assurance.
[11] We also consider a pollution measure based only on Scope 1 and Scope 2 emissions and find consistent results (untabulated).

lowest deception score as truthful $(TruthfulCEO = 1)$.[12,13]

3.3 Regression models

CEO integrity, environmental performance, and voluntary environmental disclosures

To analyze whether CEO integrity is associated with a firm's greenwashing, we estimate the following OLS regression:

$$GreenTweets_{kt} = \beta_0 + \beta_1 Pollution_{kt} + \beta_2 TruthfulCEO_{kt}$$
$$+ \beta_3 TruthfulCEO \times Pollution_{kt} + \boldsymbol{\beta}_m \textbf{TwitterControls}_{kt}$$
$$+ \boldsymbol{\beta}_n \textbf{CEOControls}_{kt} + \boldsymbol{\beta}_s \textbf{FirmControls}_{kt} + FE_i + FE_t + \varepsilon_{kt},$$

where k is an index for the firm and t an index for time. FE_i with $i \in \{k, SIC\}$ is a vector of firm (FE_k) or industry-fixed effects (FE_{SIC}) to account for firm or industry-specific differences across firms and FE_t is a vector of year-fixed effects to account for differences over time. We estimate the regression model with robust standard errors clustered at the firm-year level.[14]

We build on Crowley et al. (2022) and Marquis et al. (2016) for the research design and the selection of control variables. The sample firms may differ in their use of Twitter, which might be correlated with firms' environmental tweets. Therefore, we include **TwitterControls**, a vector of control variables related to Twitter. To account for the firm's Twitter use, we include *TwitterActivity* calculated as the total number of tweets, less the number of environmental tweets. To account for the popularity among followers, we include average *LikesPerTweet* and *RepliesPerTweet*, calculated as the ratio of the number of likes or retweets over the total number of tweets, respectively.

CEOControls represents a vector of control variables related to CEO characteristics. To control for the CEO's status and position, which might be related to the CEO's disclosure activities, we include *NewCEO*, a dummy variable indicating whether the CEO assumed the role in the current fiscal year, and *TenureCEO*, indicating the CEO's tenure with the firm.

Following Marquis et al. (2016), we include several firm-related control variables, as research shows that a firm's financial performance is related to its environmental actions. **FirmControls** represents a vector of control variables related to firm characteristics. *FirmSize* is the natural logarithm of total assets. *SalesGrowth* is the relative change in sales.

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[12] We repeat the analysis performing a median split to classify CEOs as truthful or deceptive. While we would benefit in terms of observations when using a median split, a tertial split is the stricter approach to classify CEOs' types, as we avoid comparing adjacent observations. For the median split, the results are consistent (untabulated).

[13] As an alternative approach to identifying truthful CEOs, we follow Newman et al. (2003) and assume that deceptive individuals show lower cognitive complexity, use fewer self-references and other-references, and use more negative emotion words. Broadly stated, the results are qualitatively unchanged (see Table A.2).

[14] For robustness, we repeat the analyses clustering standard errors separately by firm and by year. The results are consistent (untabulated).

To control for firm performance, we include the firm's return on assets (*ROA*), and the market-to-book value (*MTB*). As firms' possibility to change their emissions (*Pollution*) likely depends on the absolute level of emissions, we include *CarbonEmissions* as a proxy for the emission level, calculated as the sum of the firm's Scope 1, Scope 2, and Scope 3 emissions in millions. To control for the firm's inherent risk, we include *LeverageRatio*, calculated as the ratio of the firm's total liabilities and total assets. Firm controls are winsorized at a 1% cutoff. Following prior research, we lag firm controls by one year.

CEO integrity, voluntary environmental disclosures, and assessed environmental performance
To analyze how information recipients assess greenwashing in combination with CEO integrity, we estimate two regressions: First, we consider investors' assessed environmental performance:

$$AR_{k,d,d+3} = \beta_0 + \beta_1 GreenTweets_{kd} + \beta_2 TruthfulCEO_{kd}$$
$$+ \beta_3 TruthfulCEO \times GreenTweets_{kd} + \boldsymbol{\beta_m} \textbf{TwitterControls}_{kd}$$
$$+ \boldsymbol{\beta_n} \textbf{CEOControls}_{kd} + \boldsymbol{\beta_s} \textbf{FirmControls}_{kd} + FE_i + FE_d + \varepsilon_{kd},$$

where k is an index for the firm and d an index for time. FE_i with $i \in \{k, SIC\}$ is a vector of firm (FE_k) or industry fixed effects (FE_{SIC}) and FE_d is a vector of year fixed effects to account for differences over time. We estimate regression Model (2) with robust standard errors clustered at the firm-year level.

Extending Model 1, we include additional **FirmControls** to account for potential confounders related to information recipients' assessment of environmental disclosures. We include $AR_{k,d-30,d}$, calculated as cumulative abnormal stock returns over the 30 days prior to the disclosure to account for a possible momentum in abnormal returns. We also include *StockVolatility*, calculated as the volatility of stock returns in a 30-day window prior to the disclosure. To account for investors', intermediaries', and other market participants' attention reflecting news or other confounding events related to stock prices (Da et al. 2011; deHaan et al. 2021), we include the investor search volume index (*ISVI*) from Google. To arrive at a daily measure, we follow the 4-steps outlined by deHaan et al. (2021). First, we directly download the monthly investor-specific Google search volume (Category 107) from Google trends. Second, we download the daily ISVI for each month in the sample period. Third, we adjust the daily ISVI by multiplying it with the monthly ISVI scaled by 100. Fourth, we rescale the daily ISVI, such that it ranges from 0 to 1. Additionally, we include the one-year-lagged *Pollution* measure as an additional control.

Second, we consider ESG analysts' assessment of environmental performance:

$$RatingPerformance_{kt} = \beta_0 + \beta_1 GreenTweets_{kt} + \beta_2 TruthfulCEO_{kt}$$
$$+ \beta_3 TruthfulCEO \times GreenTweets_{kt} + \boldsymbol{\beta_m} \textbf{TwitterControls}_{kt}$$
$$+ \boldsymbol{\beta_n} \textbf{CEOControls}_{kt} + \boldsymbol{\beta_s} \textbf{FirmControls}_{kt} + FE_i + FE_t + \varepsilon_{kt},$$

where k is an index for the firm and t is an index for time. FE_i with $i \in \{k, SIC\}$ is a vector of firm (FE_k) or industry fixed effects (FE_{SIC}) and FE_t is a vector of year fixed effects. We estimate Model (3) with robust standard errors clustered at the firm-year level. We include additional **FirmControls** extending Model 1. We include the prior year's environmental rating performance (*RatingPerformancePY*) to control for a potential trend in the firm's rating performance. As a proxy for investor attention, we include the monthly *ISVI* and rescale it such that it ranges from 0 to 1. Last, we include the one-year-lagged *Pollution* measure. In Appendix A, we provide detailed definitions of all variables.

3.4 Descriptive Statistics
Table 2 reports the descriptive statistics of the main variables. Panel A displays the variables used in regression models (1) and (3), which is the monthly analysis of green tweets (H1) and environmental ratings (H2); Panel B shows the variables used in Model (2), which is the daily analysis of abnormal returns (H2).

In Panel A, monthly *GreenTweets* range between zero and 113 tweets per month. The firm's residual tweets (*TwitterActivity*) range between zero and 204 per month. On average, a tweet receives 32.81 likes and 0.83 replies. The average annual pollution (*Pollution*) is 0.27, indicating an average annual increase in carbon emissions of 27%. However, the median annual pollution is -0.02, indicating an annual decrease of 2%. Thus, a majority of firms are reducing their carbon emissions. The average annual environmental rating score of firms (*EnvironmentalRating*) is 78.75, of a possible score of 100. The average *RatingPerformance* is 0.02. In Panel B, the average *GreenTweets* amount to 0.98, ranging from zero to a maximum of 23 tweets per day. The residual tweets range between zero and 204. On average, a tweet receives 46.30 likes and 1.25 replies. The average annual pollution is 0.38. Three-day cumulative abnormal returns range from -0.07 to 0.08, with an average of 0.0005. 30-day cumulative abnormal returns range from -0.19 to 0.18, with an average of -0.0016.[15]

3.5 Correlations
In Table 3, we report the Pearson correlations among the main variables. In Panel A, we present the correlations for firm-month observations, and in Panel B, for firm-day observations.

In Panel A, regarding the relationship between environmental performance and voluntary environmental disclosures, we find no significant correlation between *Pollution* and *GreenTweets*. This missing significance can be attributed to the bivariate nature of the correlations. As the predicted direction of the correlation between the two variables depends on CEO truthfulness, the relation is concealed on average. Regarding the relation between voluntary environmental disclosures and assessed environmental performance, we find no significant correlation between *GreenTweets* and *RatingPerformance*, again attributable to the bivariate nature of this analysis.

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[15] The differences in descriptive statistics in Panels A and B are driven by differences in the availability of data in the sample composition. The results remain qualitatively unchanged if we repeat the analysis of Model (2) with a sample restricted to the observations included in Panel A and vice versa.

In Panel B, we find a positive and statistically significant (p-value < 0.05) correlation between *GreenTweets* and $AR_{d,d+3}$, indicating that, on average, green tweets are valued by investors. On average, the expected positive correlation for high-integrity CEOs appears to outweigh the expected negative correlation for low-integrity CEOs. The remaining relevant correlations are reasonably low, which mitigates potential multicollinearity concerns. We postpone a more detailed discussion of the result to the regression analysis.

4. RESULTS

4.1 CEO integrity, environmental performance, and voluntary environmental disclosures

Table 4 presents the regression analysis results investigating whether CEO integrity moderates the relationship between environmental performance and voluntary environmental disclosures. Column (1) presents the results for Model (1) with industry-fixed effects. Column (2) adds standard errors clustered at the firm-year level. In Columns (3) and (4), we repeat the analysis, including firm fixed effects.

In Column (1), consistent with expectations, we find a positive and statistically significant (p-value < 0.01) coefficient on *Pollution*. An increase in annual pollution by one standard deviation is associated with almost one additional green tweet per month. The interaction between *TruthfulCEO* and *Pollution* is negative and statistically significant (p-value < 0.01), thus providing support for Hypothesis 1. An increase in *Pollution* by one standard deviation is associated with a decrease of roughly two green tweets per month. These results suggest that deceptive CEOs misrepresent their environmental performance and more intensively use green tweets when pollution is increasing. In contrast, truthful CEOs appear to align environmental disclosures and environmental performance. Additionally, we find a positive and significant (p-value < 0.05) coefficient on *TruthfulCEO*, indicating that truthful CEOs, on average, display a higher level of environmental disclosures.

Column (2) extends the specification by including robust standard errors. The main coefficients of interest remain significant under this stricter specification. Regarding the control variables, we find a positive and significant (p-value < 0.01) association between *TwitterActivity* and *GreenTweets*, suggesting that, on average, environmental disclosures on Twitter are higher when Twitter is used more intensively.

For robustness, we repeat the analysis, including firm fixed effects. The results are reported in Columns (3) and (4). While the coefficients on the interaction terms remain significant, the coefficients on *Pollution* are no longer significant. This loss in significance might be attributed to the small effect size of *Pollution* and that firm fixed effects, at least partly, capture the behavior of deceptive CEOs.

Concluding, the evidence in Table 4 suggests that low-integrity CEOs use voluntary environmental disclosures as a form of impression management to distract from adverse

environmental performance. In contrast, high-integrity CEOs appear to align environmental disclosures and environmental performance.

4.2 CEO integrity, voluntary environmental disclosures, and assessed environmental performance

Next, we investigate whether CEO integrity moderates the relationship between voluntary environmental disclosures and assessed environmental performance. First, we examine the association between green tweets and abnormal financial returns. Table 5 presents the results for Model (2). Column (1) presents the results with industry fixed effects and robust standard errors clustered at the firm-year level. We investigate the short-term abnormal returns over a three-day window. In Column (2), we consider a long-term window and cumulative abnormal returns over 30 days. In Columns (3) and (4), we repeat the analysis, including firm fixed effects.

In Column (1), we find a negative and statistically significant (p-value < 0.01) coefficient on *GreenTweets*, suggesting that deceptive CEOs' environmental disclosures are associated with an adverse investor reaction. An increase in green tweets of one standard deviation is associated with a decrease in abnormal returns by 20 basis points. The interaction between *TruthfulCEO* and *GreenTweets* is positive and statistically significant (p-value < 0.01), thus supporting Hypothesis 2. An F-test of the aggregated coefficients capturing the main effect and the interaction effect reveals a positive and significant (p-value < 0.01) coefficient for truthful CEOs, indicating that investors value truthful CEOs' green tweets. For truthful CEOs, an increase of one standard deviation in green tweets is associated with a 0.6 basis-point increase in abnormal returns. These observations suggest that investors consider CEO characteristics when assessing their voluntary disclosures on Twitter, thereby unmasking deceptive CEOs' greenwashing attempts.

Regarding the control variables, we find a positive and significant (p-value < 0.01) coefficient on abnormal returns cumulated over the 30 days before the green tweet, suggesting some momentum in current abnormal returns. Additionally, we find a negative and significant (p-value < 0.1) coefficient on *StockVolatility*, suggesting that, on average, a higher risk appears to harm abnormal returns.

Column (2) displays the regression results when considering 30-day cumulative abnormal returns as the dependent variable. We no longer report a significant relation between *GreenTweets* and $AR_{d,d+30}$. Similar to prior work (e.g., Nekrasov et al. 2021), disclosures on social media seem to trigger a short-time effect that vanishes or even reverses over the longer run. For robustness, in Columns (3) and (4), we repeat the analysis, including firm fixed effects. The results remain qualitatively unchanged.

Second, we examine the association between green tweets and environmental rating performance. We estimate the regression according to the specification outlined in Model (3). Table 6 presents the results of the regression analysis. Column (1) presents the results with industry-fixed effects. Column (2) adds standard errors clustered at the firm-year level. In Columns (3) and (4), we repeat the analysis, including firm fixed effects.

In Column (1), we report a negative and statistically significant (p-value < 0.01) coefficient on *GreenTweets*, suggesting that deceptive CEOs' environmental disclosures are associated with a decrease in ESG-analysts' evaluations of firms' environmental performance. An increase in *GreenTweets* by one standard deviation is associated with a decrease of 5% relative to the standard deviation of *RatingPerformance*. The coefficient on the interaction between *TruthfulCEO* and *GreenTweets* is positive and statistically significant (p-value < 0.01), thus supporting Hypothesis 2. An F-test of the aggregated coefficients capturing the main effect and the interaction effect documents a positive and significant (p-value < 0.01) coefficient for truthful CEOs. Additionally, we find a negative and significant (p-value < 0.1) coefficient on *TruthfulCEO*, indicating, on average, a lower rating performance of truthful CEOs' firms.

However, this level effect vanishes in the stricter specification in Column (2). In Column (2), we add standard errors clustered at the firm-year level to the model. While the main coefficients of interest remain unchanged in this stricter specification, the coefficient on *TruthfulCEO* is no longer significant, indicating that the level effect is not particularly strong.

Regarding the control variables, in Column (2), we find a positive and statistically significant (p-value < 0.1) coefficient on *TenureCEO*, suggesting that CEOs with a longer tenure with the firm achieve a higher rating performance. The coefficient on *RatingPerformancePY* is negative and statistically significant (p-value < 0.1). Last, the negative and statistically significant (p-value < 0.05) coefficient on *Pollution* documents that lower environmental performance in terms of higher pollution is reflected in ESG analysts' assessment of firms' environmental performance.

For robustness, in Columns (3) and (4), we repeat the analysis, including firm fixed effects. The results remain qualitatively unchanged.

Concluding, the evidence in Tables 5 and 6 suggests that information recipients, i.e., investors and ESG analysts, appear to consider CEO integrity when evaluating disclosures, thereby unmasking low-integrity CEOs' misleading disclosure behavior. In contrast, information recipients value voluntary environmental disclosures by high-integrity CEOs.

5. CONCLUSION

We investigate whether CEO integrity is associated with a firm's greenwashing, i.e., voluntary environmental disclosures that do not reflect environmental performance. Greenwashing comes with benefits and costs for the CEO. While a firm's green reputation can generate positive stakeholder awareness and influence purchase and investment decisions (Luo and Bhattacharya 2006; Marquis et al. 2016; Balluchi et al. 2020), overly favorable green tweets entail the risk that stakeholders perceive environmental disclosures as misleading and hypocritical, thus harming the CEO's reputation (Wagner et al. 2009; Lee et al. 2013).

A low-integrity CEO is probably not concerned about putting their reputation at risk through

questionable disclosure practices. In contrast, the cost of a harmed reputation for a high-integrity CEO is arguably higher, and they are likely to refrain from such disclosures. Consequently, we expect that CEO integrity moderates the relationship between environmental performance and voluntary environmental disclosures. The results support this hypothesis. We find that low-integrity CEOs, in contrast to high-integrity CEOs, engage in greenwashing in the form of using voluntary environmental disclosures on Twitter that do not reflect firms' environmental performance. Thereby, the study contributes to the literature investigating drivers of greenwashing (e.g., Cho et al. 2015; Clarkson et al. 2008).

We also evaluate how information recipients, i.e., investors and ESG analysts, assess voluntary environmental disclosures in combination with CEO integrity. Building on attribution theory, we argue that information intermediaries consider CEO integrity when evaluating voluntary environmental disclosures to assess the firm's environmental performance (Fiske and Taylor 1991). Following this reasoning, we expect that CEO integrity moderates the relation between voluntary environmental disclosures and assessed environmental performance. We investigate investors' and ESG analysts' environmental performance assessments, finding that information intermediaries consider the integrity of CEOs and thereby unmask low-integrity CEOs' greenwashing. Specifically, voluntary environmental disclosures by low-integrity CEOs are associated with a decrease in abnormal returns and environmental ratings. Thereby, the study adds to the literature assessing whether information recipients use managerial characteristics to evaluate disclosures (e.g., Hope and Wang 2018; Loughran and McDonald 2011).

The study has limitations. First, we measure CEO integrity not directly but at a distance, as we use linguistic analysis of the CEO's written statement. Thus, the measure might not be as precise as measures that take into account psychological assessments or survey employees. To increase the robustness of the measure, we consider Newman et al.'s (2003) prediction equation for deceptive behavior as an alternative linguistic measure (Appendix A). While the results are consistent, the alternative linguistic measure is also of indirect nature. Therefore, future research could consider more direct measures of CEO integrity. Second, we focus on CEO truthfulness as an important dimension of CEO integrity. As integrity is a broad and multi-dimensional construct, future work could consider other facets of integrity.

Third, we rely on Refinitiv's Environment Pillar Score to capture ESG analysts' assessment of firms' environmental disclosures. Literature documents that ESG scores display a strong divergence across rating agencies and might not reflect firms' true environmental performance (Berg et al. 2022; Christensen et al. 2022). Future research could evaluate whether CEO integrity is a missing piece to understanding the divergence of ESG ratings.

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