

Climate-related cheap talk and management earnings forecasts

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Abstract

This study investigates the relationship between the likelihood and accuracy of management earnings forecasts and the prevalence of greenwashing among U.S. firms for the period 2006 to 2022. We assess greenwashing by analyzing non-specific climate-related disclosures concerning actions and commitments ("cheap talk") in annual reports, employing a natural language processing approach (ClimateBert). Our results indicate that the probability of disclosing management earnings forecasts within a financial year is negatively associated with the occurrence of climate related cheap talk. This suggests that greenwashing may stem from opaque business practices that emerge when firms forgo high-commitment verifiable voluntary disclosure throughout the financial year, aiming to shape stakeholder perceptions. Additionally, we observe a positive correlation between management earnings forecast errors and climate-related cheap talk, particularly when firms fail to meet their own management guidance. Climate-related cheap talk may accompany management guidance errors to divert stakeholder attention from the firms' underperformance and to mitigate market penalization. Collectively, our findings underscore the role of management earnings forecasts in shaping corporate greenwashing and identify signals and determinants of climate-related cheap talk.

Keywords: management earnings forecasts, CEO characteristics, CEO compensation, climatebert, climate disclosure, cheap talk

JEL classification: M41, M12, M14

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1 Introduction

Over the last decade the awareness of climate protection and the commitments to an emission neutral economy have increased. Many companies aim for a green transition and implement environmental initiatives, strategies and actions to improve their environmental performance (Wang, 2023; Yuan et al., 2024). These green commitments and actions are often accompanied by improvements in environmental disclosure (Zhang, 2021). However, some firms may resort to greenwashing practices to enhance their legitimacy and signal positive environmental developments, thereby attempting to bolster their reputation (Amores-Salvado et al., 2023). Such a practice may misleads external stakeholders regarding the true environmental efforts being made (Berrone et al., 2017; Zhang, 2021). Hence, the quality of disclosure is crucial for stakeholders, particularly in considering climate-related risks in the pricing and hedging strategies, as the assessment of the impacts of climate commitments on firm value is challenging (Deng et al., 2022; Engle et al., 2020; Hsu, 2023). Moreover, inaccurate sustainability information adversely affect analyst forecast accuracy (Zhang, 2023b). Consequently, the literature has increasingly focused on whether environmental disclosure genuinely reflects firms' true environmental efforts and commitments or merely represent greenwashing practices, as well as on the determinants that shape these disclosure practices.

To shed light on this debate, this study examines the relationship between management earnings forecasts (management guidance) and firms' greenwashing behavior. Herein, we focus on climate-related cheap talk, which pertains to the disclosure of non-specific climate-related actions and commitments in annual reports (Bingler et al., 2024). We posit that firms that refrain from voluntarily issuing management

earnings forecasts avoid high-commitment, verifiable forms of financial disclosure, resulting in lower accountability and external verification pressure in their financial communications. In this context, greenwashing may arise from non-transparent business processes with a lower likelihood to voluntarily disclose management guidance information throughout the financial year (information transparency) (Wei, 2023)). Consequently, managers may substitute earnings guidance with climate-related cheap talk to shape stakeholder perceptions of the underlying financials without incurring the costs associated with precise, performance-based forecasting.

Additionally, firms that underperform relative to their own management earnings forecast may use climate-related cheap talk to divert stakeholder attention from short-term financial underperformance and validate the inaccurate management guidance to avoid market penalization (Hail et al., 2021; Hope et al., 2023; Patell, 1976; Waymire, 1985). Specifically, high management guidance errors may lead to credibility problems. In response, firms engage in greenwashing as a strategic communication tactic to retrain legitimacy. Thus, firms do not seem to explain explicitly guidance errors with green actions. Instead, their explanations regarding the development of costs tend to be broadly formulated. The annual report of Entergy Corp. for fiscal year 2015 shows such a broad formulation after facing a negative forecast error. Within the 10-k report higher capital expenditures influencing the fiscal year earnings are non-specifically related to business restructuring, regulatory constraints and environmental regulations. The firm states: "Environmental regulations are subject to change, further compliance costs cannot be precisely estimated" (entergy corporation, 2015). The example shows that difficulties in earnings prediction may be vaguely explained within annual reports.

To address our research questions, we analyze a sample of U.S. listed firms from 2006 to 2022, linking data from four different databases with data from the transformer-based language model ClimateBert and hand-collected data on CEO characteristics.

Our empirical examination reveals a negative association between the probability to disclose a management earnings forecast and climate-related cheap talk, suggesting that managers indeed substitute management earnings forecasts with cheap talk to influence stakeholders' perceptions. Furthermore, management guidance error is positively associated with climate-related cheap talk in case of underperforming the postulated management guidance. This association is increasing with the magnitude of the management earnings forecast error, indicating that managers utilize climate-related cheap talk to divert stakeholder attention from the firms' underperformance.

1

To further investigate the determinants of climate-related cheap talk in more details, this paper analyzes the characteristics and experiences of these decision makers disclosing climate-related "cheap talk" in the annual reports. Drawing on upper echelon theory, postulating a significant influence of the experiences and characteristics of the main decision makers on the firm's decisions and actions (Hambrick and Mason, 1984), we find significant associations between various CEO characteristics and climate-related cheap talk. Our results reveal a negative association between the level of add-on competency and climate-related cheap talk indicating that CEOs with unexpected compensation levels investigate less in greenwashing

¹In addition to serving as an explanation for management earnings forecast errors, a negative association may also be observed as an underlying deficiency in both, managerial abilities to forecast and managerial abilities to disclose concrete sustainability information.

activities. Furthermore, male CEOs and CEOs with a longer tenure tend to exhibit more climate-related cheap talk.

Overall, we contribute to the literature on sustainability disclosure and management earnings forecasts in several key ways. First, the study provides a comprehensive analysis of the relationship between management guidance and climate-related cheap talk. In addition to examining guidance disclosure probability, our analysis of the magnitude of the management guidance errors sheds light on the usage of greenwashing as a complementary narrative explaining negative forecast errors. Second, we enhance the understanding of cheap talk measurement by incorporating CEO characteristics and ESG scores in a further analysis. This enables a more nuanced interpretation of sustainability communication within firms. Third, contrary to previous literature, we assess disclosure quality by using a sophisticated text analysis tool. Specifically, we employ the ClimateBert model developed by Webersinke et al. (2022), which is pretrained on climate-related texts and thus particularly well-suited for screening annual reports concerning climate related actions and commitments to identify greenwashing behavior. Compared to earlier studies that measure greenwashing through discrepancies between ESG disclosure and ESG performance scores, our text analysis allows for a broader screening of the detailed information contained in annual reports. This facilitates the identification of explanatory narratives within annual reports, beyond merely capturing subtle linguistic cues and contextual nuances indicative of greenwashing. Furthermore, in contrast to traditional natural language processing methods, the deep learning approach offers an independent and more precise tool to distinguish between specific and superficial commitments in the analysis of vast amounts of disclosure data (Bingler et al., 2024). Finally, this

study supports stakeholders to identify and understand signals and determinants of climate-related cheap talk in disclosures of a firm.

2 Theoretical Background & Hypotheses development

Following Seele and Schultz (2022) and Bowen (2014), greenwashing is characterized as a sustainable disclosure strategy that benefits firm while being harmful for the society. Firms stay either silent about unobservable negative information or emphasize positive aspects of their sustainable performance and actions. Dorfleitner and Utz (2024) define greenwashing as the gap between substantive and symbolic actions. Summarizing these definitions, Yuan et al. (2024) identify three strategies for greenwashing: exaggerating strategy (talk more than action) distracting strategy (cover bad news with positive news) and window-dressing strategy (confuse public with irrelevant activities). In this study, we focus on the analysis of an exaggerating strategy, specifically climate-related "cheap talk"² based on the disclosure of non-specific climate-related actions and commitments³ in annual reports (Bingler et al., 2024).

Greenwashing strategies are employed to enhance legitimacy, convey positive signals, and strengthen reputation (Amores-Salvado et al., 2023; Berrone et al., 2017).

Prior literature identifies several drivers of greenwashing. In addition to the regula-

²The definition "cheap talk" is based on Bingler et al. (2024) and does not relate to the analytical model of Crawford and Sobel (1982), who argue that cheap talk is ignored from the recipient of the information.

³A concrete commitment pertains to a specific and clearly defined action, thereby signaling a higher degree of credibility regarding the firm's environmental policy. In contrast, a non-concrete commitment remains vague and unspecific, making its implications and credibility difficult to assess.

tory environment (Laufer, 2003) and industry characteristics (Szabo and Webster, 2021), firm-specific characteristics have been identified as determinants of greenwashing behavior. Gregory (2021) demonstrates a positive association between the cost of capital and greenwashing behavior and Epure (2022) shows that greenwashing is used to mitigate financial distress, as these strategies may yield short-term returns and lead to equity mispricing (Li et al., 2024; Lin et al., 2023; Yuan et al., 2024). Additionally, firms may use greenwashing to influence analyst reactions. Studies that examine relationships between analyst forecast accuracy and a firm's greenwashing behavior indicate that inaccurate sustainability information negatively affects analyst forecast accuracy (Zhang, 2023b). Wei (2023) supports the findings of Zhang (2023b) by examining environmental disclosure and analyst forecast accuracy. Schiemann and Tietmeyer (2022) find similar associations between ESG controversies and analyst forecast accuracy. Furthermore, Rossi and Candio (2023) highlight the importance of mitigating information asymmetries to improve analyst forecast accuracy through the disclosure of sustainability-related activities.

This study investigates the role of management earnings forecast (likelihood and precision) in shaping greenwashing strategies, defined as non-specific climate-related commitments and actions in firms' disclosures (talk more than action). As a voluntary disclosure tool, management earnings forecasts communicate firms' earnings predictions and constitute an important signal to the market. Prior literature on voluntary disclosure theory shows that firms with superior sustainability performance are more likely to voluntarily disclose sustainability information (Hummel and Schlick, 2016). Additionally, stakeholder theory (Freeman (2010)) postulates a

positive relationship between ESG performance and financial performance (see for example Aydogmus et al. (2022); Chen et al. (2023); Fu and Li (2023)).

We argue that firms that do not voluntarily issue management earnings forecasts avoid a high-commitment, verifiable form of financial disclosure, thereby facing lower accountability and external verification pressure in their financial communication. In this context, greenwashing may arise from nontransparent business processes with a lower likelihood to voluntarily disclose management guidance information throughout the financial year (information transparency) (Wei, 2023)). Herby, managers may substitute earnings guidance with climate-related cheap talk to influence stakeholder perceptions about the underlying financials without incurring the costs associated with precise, performance-based forecasting. The validation of the firms' explanations is challenging due to the absence of a benchmark for measuring their performance (lower transparency). Consequently, a lower likelihood to issue management earnings forecast is associated with non-specific climate-related "cheap talk" within the annual reports.

Hence, we formulate the first hypothesis as follows:

Hypothesis 1: The probability of management earnings forecast issuance is negatively associated with climate-related cheap talk.

In case of a management earnings forecast disclosure, the accuracy of this management guidance may influence the greenwashing strategies employed by a firm. Management earnings forecast accuracy is crucial, as inaccurate management guidance may lead to market penalization (Waymire, 1985). In contrast to greenwashing

strategies, the credibility of management earnings forecasts can be more readily assessed by market participants. Potential biases in sustainability disclosures are often difficult to detect and typically become apparent only with a time lag (Li et al., 2024; Lin et al., 2023; Yuan et al., 2024). Greenwashing strategies aim to enhance legitimacy and strengthen reputation, similar to earnings management strategies employed by firms. Both greenwashing and earnings management are opportunistic management decisions intended to bias stakeholders' perceptions of a firm's actions and reported earnings. Prior literature provides evidence of an association between earnings management and management earnings forecasts. Specifically, Kasznik (1999) shows a positive association between the costs associated with management earnings forecast error and discretionary accruals. In a similar vein, managers may seek to reduce these costs through greenwashing strategies.

We argue that climate-related cheap-talk is a measure to bias impressions and influence the judgment of the earnings of a firm. In contrast to accrual management, which may aim to mitigate short-term reactions of stakeholders, climate-related cheap talk may strategically seek to strengthen reputation and long-term trust among stakeholders (Amores-Salvado et al., 2023). We hypothesize that inaccuracies in management earnings forecasts may prompt managers to amplify greenwashed disclosures as a strategic mechanism to rationalize performance deviations and mitigate the reputational and financial consequences associated with management guidance errors. Specifically, we expect lower management earnings forecast accuracy to be positively associated with the use of non-specific, climate-related statements in corporate reporting. A positive association between greenwashing and future projections also aligns with prior empirical evidence focusing on ana-

lyst forecasts (Rossi and Candio, 2023; Schiemann and Tietmeyer, 2022; Wei, 2023; Zhang, 2023b).

Hence, we formulate the second hypothesis as follows::

Hypothesis 2: The management earnings forecast error is positively associated with climate-related cheap talk.

Furthermore, prior literature indicates that accurate management earnings forecasts help to build a reputation and reduce market penalization (Allee et al., 2021). However, Baginski et al. (2004) provide evidence that bad news forecasts are more likely to be accompanied by additional explanatory attributions. Building on this, we hypothesize that negative management earnings forecast errors (downside errors) are associated with more pronounced greenwashing disclosures than cases in which firms beat their management earnings forecasts (surprise errors), as managers seek to explain negative deviations from expectations. Accordingly, we test hypothesis 2 for the full sample as well as separately for firms with downside and surprise management guidance errors.

We contribute to the existing literature by examining the association of management earnings forecast and greenwashing behavior. Contrarily to prior literature that examines analyst forecasts, we contribute to the literature by analyzing the association of greenwashing strategies and management guidance. While analyst forecasts capture stakeholder reactions after greenwashing strategies, the paper examines probable climate-related cheap talk within annual reports following manage-

ment decisions regarding management guidance disclosure. Additionally, we contribute by examining opportunistic management behavior from a sustainability perspective, rather than solely based on firm financials (greenwashing bias stakeholders perception similar to earnings management). We argue that firms with inaccurate management guidance seek to avoid credibility and legitimacy problems through strategic communication tactics. Herein, the greenwashing behavior is measured as the disclosure of non-specific climate related commitments and actions. While prior literature has used discrepancies between performance and disclosure scores, we use a sophisticated textual analysis tool (Climatebert), which is a natural language processing methodology based on the ClimateBert model of Webersinke et al. (2022). This tool ensures a more precise distinction between superficial and specific actions and commitments.

3 Economic modelling

This section outlines the empirical models employed to test the hypotheses presented in this following section. To assess hypothesis 1 (H1), we conduct the following panel regression with year-fixed effects.⁴

$$CTI_t = \alpha + \beta Prob_t + \beta MVE_t + \beta MB_t + \beta Litigation_t + \beta CFO/TA_t + \beta Leverage_t + \beta RoA_t + \beta Loss_t + \beta Increase_t + \lambda_t + \epsilon \quad (1)$$

⁴In order to specify the tested model we apply the Hausman test (Hausman, 1978), which is significant and indicates the use of a fixed-effects model. We use firm-specific control variables instead of firm-fixed effects to prevent misinterpretation in cases where firms maintain constant guidance policies of. To account for serial correlation we use the Wooldridge Test (Wooldridge, 2010) and for cross sectional dependence the Breusch-Pagan LM (Breusch and Pagan, 1980). We correct for heteroscedasticity and autocorrelation by using Huber-White standard errors (Huber, 1967; White, 1980).

Measurement of greenwashing is challenging (Dorfleitner and Utz, 2024). Prior literature often proxies this behavior using discrepancies between ESG disclosure and ESG performance scores (Lin et al., 2023; Yu et al., 2020; Zhang, 2023a). However, Kathan et al. (2025) examine the association between ESG scores and greenwashing behavior, demonstrating that higher ESG scores are positively associated with increased greenwashing. Additionally, the existence of multiple ESG score providers, each with different assessments of firms’ ESG exposures, may exacerbate information asymmetries for investors. Therefore, recent studies increasingly rely on disclosure-based measures of greenwashing (Dorfleitner and Utz, 2024; Li et al., 2024).

Given the substantial volume of corporate disclosure data, manual analysis can be cumbersome. Several studies (Grüning, 2011; Sautner et al., 2023) in the field have utilized traditional natural language processing methods (e.g. bag of words approach), but these methods are gradually replaced by methods using deep learning techniques. Language models trained using deep learning approaches, such as BERT (Bidirectional Encoder Representations from Transformers) appear to be more precise due to their training on millions of textual datasets (Devlin et al., 2018). ClimateBert introduced by Webersinke et al. (2022)⁵, utilizes climate-specific training data to enhance accuracy of the results when analyzing textual data related to climate. The model was trained with more than 2 million climate-related paragraphs enabling the analysis of textual data to discern sentiment and topics within the examined dataset.

In this study, *CTI* refers to the cheap talk index based on the Climatebert model of Webersinke et al. (2022). It is the ratio of non-specific climate related

⁵for more extensive discussion we refer to Webersinke et al. (2022)

commitments and actions to all climate-related commitments and actions within annual reports.

Following Bingler et al. (2024), the following equation describes the *CTI*⁶:

$$CTI_{i,t} = \frac{commit \cap nonspec_{i,t}}{commit_{i,t}} \quad (2)$$

The *CTI* is a ratio between 0 and 1, representing the percentage of non-specific climate related action and commitments of a firm. We scale the ratio by multiplying by 100 to interpret the *CTI* as percentage.

The main independent variable *Prob* is a dummy taking the value of 1 in case a management guidance is published (Baik et al., 2011) throughout a year, zero otherwise.

To control for firm specifics, we use the following control variables: *MVE* represents the log of the market value of equity of a firm. Previous research shows a negative association between size and earnings management, as higher political costs reduce reporting aggressiveness (Ali and Zhang, 2015; Watts and Zimmerman, 1986). Additionally, empirical studies control for organizational size as a factor for explaining sustainability disclosure, since preparation costs for disclosures should decrease with firm size. Furthermore, monitoring of the management increases with firm size. (Cho and Patten, 2007; Hail et al., 2021; Lang and Lundholm, 1993; Marquis et al., 2016) *MB* is the market to book ratio of firm's equity. Earlier literature suggests that firms with a higher growth potential are more likely to manipulate earnings (Frankel et al., 2002). Moreover, Kim and Lyon (2015) show a positive

⁶Webersinke et al. (2022) describes with concrete examples in the article how the Climatebert model does the clustering of the analysed data (in e.g. climate-related/not climate related)

association between firm growth and greenwashing. To account for the exposure of industries to litigation risk, we include a *litigation* variable. Following Baik et al. (2011), this is a dummy variable for industries with the SIC codes 2833-2836, 3570-3577, 7370-7374, 3600-3674. *Leverage* is the ratio of debt to book value of equity. Prior literature indicates a negative association between leverage and earnings management due to higher a level of monitoring (Becker et al., 1998). Alternatively, leverage may influence sustainability disclosure for legitimacy and reputational reasons (Kim and Lyon, 2015; Marquis et al., 2016). *RoA* is the net income relative to assets, measuring extraordinary performance (Ali and Zhang, 2015). Following Ajinkya et al. (2005), negative actual net income reduces the informativeness of disclosures. The *Loss* variable is a dummy that indicates whether the actual net income is negative. In case of a negative actual net income the variable is 1, otherwise 0. *CFO/TA* represents the cash flow of operations divided by total assets. Ashbaugh et al. (2003) show a negative association between cash flow of operations and earnings management. We expect similar negative associations between cash flow of operations and greenwashing disclosure. We measure business growth by the increase in net income (Baik et al., 2011). The variable *Increase* is a dummy with a value of 1 indicating a higher net income compared to the previous period and 0 otherwise.

To test the hypothesis 2 (H2), which examines the association between management earnings forecast accuracy and the disclosure of corporate climate commitments and actions, we estimate the following panel regression with year-fixed effects.⁷ We run the model three times. First, we use the full sample. Second, we

⁷In order to specify the tested model we apply the Hausman test (Hausman, 1978), which is significant and indicates the use of a fixed-effects model. We use firm-specific control variables

partition the sample into firms with a negative forecast error (downside error) and firms with a positive forecast error (surprise error) within a given year. This pooling allows us to analyze differences in greenwashing behavior depending on whether firms miss or exceed their management guidance.

$$CTI_t = \alpha + \beta Acc_t + \beta MVE_t + \beta MB_t + \beta Litigation_t + \beta CFO/TA_t + \beta Leverage_t + \beta RoA_t + \beta Loss_t + \beta Increase_t + \beta TimeDelta_t + \lambda_t + \epsilon \quad (3)$$

The main independent variable *Acc* represents the error of the management earnings forecast and is calculated by subtracting the earnings per share (EPS) of the management earnings forecast from the actual EPS. The management guidance error is negative if the earnings target is missed and positive in case the management earnings forecast is met. We utilize similar control variables (size, sales concentration, loss, increase) as for testing the association between the disclosure probability of management earnings forecast and the cheap talk index. However, following Baik et al. (2011), we add a control variable, *TimeDelta*, to incorporate the timely gap between earnings release date and forecasting date. Prior research indicates a positive association between forecast error and the days between these two dates.

instead of firm-fixed effects to avoid misinterpretation in case of constant guidance policies of firms. To account for serial correlation we use the Wooldridge Test (Wooldridge, 2010) and for cross sectional dependence the Breusch-Pagan LM (Breusch and Pagan, 1980). We correct for heteroscedasticity and autocorrelation by using Huber-White standard errors (Huber, 1967; White, 1980).

4 Data

The dataset includes annual observations of U.S. public equity firms ranging from 2006 to 2022. It consists of data from four different databases, data from the transformer-based language model ClimateBert ,as well as unique hand-collected data on firm affiliation years of the CEOs.

We retrieve management earnings forecasts data (EPS guidance, EPS guidance date) from Standard and Poor Capital IQ Pro. We include only those firms that reported at least one management earnings forecast throughout the entire time horizon in our data sample to mitigate bias stemming from firms reporting management earnings forecasts not covered by the database.

We extract market value of equity, book value of equity, total assets, cashflow of operations, total liabilities, industry classification, revenue, net income and fiscal year end date extracted from Compustat for the calculations of the control variables.

To facilitate a more nuanced understanding and interpretation of the drivers and aspects of climate-related cheap talk, we also analyze CEO characteristics and firms' ESG scores related to cheap talk. CEO specific data (age, sex, tenure, compensation, education) is obtained from Compustat and Execucomp. We hand-collected (e.g. LinkedIn, CVs on websites of firms the CEO is currently working) the start date of each CEO's employment at the firm. We use ESG scores from the LSEG workspace database.

After merging the data from the four data bases and the data of the ClimateBert transformer-based language model, we arrive at our final unbalanced sample of 876 firms, comprising 7,233 firm-year observations (influence of CEO characteristics and likelihood to disclose a management guidance on cheap talk index) for testing

our hypothesis 1. For hypothesis 2, the data sample consists of 4,080 firm-year observations (influence of management guidance accuracy on cheap talk index). The reduced sample size is attributed to the fact that the firms do not publish management guidance every year. Table 1 provides an overview of the data collection process.

Table 1: Data sample

+/-	#	Variable
	12,634	Total Firm-year observations based on Guidance Data
-	5,158	Data Cheap Talk Index
-	227	Data CEO characteristics (Age, AddComp)
-	16	Control variables (MVE, Cash flow of operations)
=	7,233	Firm-year observations used

Notes: This table contains the data collection process of our final data set of US firms for the observation period from 2006-2022 with annual observations. The management earnings forecast data is the starting point. After merging the guidance data with the cheap talk index data we loose 5,158 firm-year observations. The final data set consists of 7,233 firm-year observations.

Table 2 presents the descriptive statistics of the main variables used for our modeling. The descriptive statistics encompass the number of firm-year observations, the mean, the standard deviation and the minimum and maximum observation of the variables.

The average CTI is 59.8%, indicating a considerable level of environmental cheap talk as roughly 6 out of 10 environmental disclosures related to climate actions and commitments are non-specific. The difference between predicted EPS and the actual EPS is on average 0.99. On average, there are 178 day between the publication of management guidance and the actual earnings. The likelihood that firms disclose a management earnings forecast in a year is on average 56%. The market to book ratio is on average 3.18. 13% of the firms act in branches with high litigation risk.

Table 2: Descriptive Statistics

Variable	#	μ	σ	Min	Max
CTI	7,233	59.7608	36.229	0	100
AccuracyEPS	4,080	0.985	2.261	0	73.36
Probability	7,233	0.564	0.496	0	1
Age	7,233	56.5	6.4	34	87
Sex	7,233	0.947	0.224	0	1
AddComp	7,233	4.312	2.766	0	9
Affiliation	7,233	10.0	10.2	0	57
Tenure	7,233	6.5	6.6	0	50
MVE	7,233	22.273	1.618	15.096	28.559
MB	7,233	3.183	42.129	-2340	1291
litigation	7,233	0.126	0.332	0	1
CFO/TA	7,233	0.089	0.071	-0.688	0.564
Leverage	7,233	2.626	28.583	-908.63	872.166
RoA	7,233	0.048	0.080	-1.583	0.958
Loss	7,233	0.127	0.333	0	1
Increase	7,233	0.649	0.477	0	1
ESG score	5,601	50.778	18.958	1.300	95.160
Timedelta	4,080	178	140	7	1458

Notes: This table contains the descriptive statistics (number of observations, mean, standard deviation, minimum and maximum observation) of our final data set of US firms for the observation period from 2006-2022 with annual observations. CTI refers to the cheap talk index calculated by setting the non specific commitment climate-related paragraphs into relation with the climate-related paragraphs classified as commitment and action. AccuracyEPS refers to the forecast error of the EPS. Probability shows the likelihood that a forecast is published. The table also show the age and the sex of the CEO, whereas sex is a dummy of one in case the CEO is male. AddComp refers to the level of add-on competency of the CEOs in 10-decil ranks. The years of experience of a CEO are represented by Affiliation and Tenure. MVE and MB show the log of the market value of equity and the market to book ratio of the equity of a firm. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CFO/TA represents the cash flow of operations divided by the total assets of a firm and leverage is calculated by dividing the total liabilities over the book value of equity of the firm. RoA shows the return on total assets. The variable loss takes one in case the net income is negative and 0 otherwise. Increase is a dummy variable of one in case the EPS increased compared to the previous period, or zero otherwise. The firms' ESG score is represented by the variable ESG score. Timedelta represents the timely difference in days between the forecast disclosure and the actual earnings publication

The firms' average debt/equity ratio is 2.6. 13% of the observations pertain to loss-making firm-years and 65% of the firm-years show an increase in earnings compared to the previous year.

Table 2 also reports CEO-specific variables. In our data sample, the average CEO is 56.5 years old and is male (95 percent likelihood). The CEO has been working on average for 6.5 years in his current position in the firm. The variable affiliation indicates that the average CEO has worked at the respective firm for 10 years prior to becoming CEO.

5 Results

The following section details the empirical results obtained from testing the hypotheses individually.

Table 3 shows the results of the panel regression conducted to test hypothesis 1, in which examines the relationship between the probability to disclose management earnings forecasts and climate-related cheap talk. We reveal a strong negative association between the likelihood to disclose a management earnings forecast and the cheap talk index, indicating that higher levels of greenwashing activities are prevalent in the absence of management earnings forecast information. These findings suggest that greenwashing may substitute for management earnings forecasts, reflecting lower overall information transparency in firms' business processes throughout the financial year (information transparency), as also noted by Wei (2023). Consequently, we are able to confirm hypothesis 1.

The control variables in table 3 demonstrate a negative relationship between size and cheap talk index. This is in line with prior literature indicating that a higher

Table 3: CTI & Probability issuing guidance

	Control		Probability	
Prob			-5.800	**
			-6.70	
MVE	-1.909	**	-1.623	**
	-4.73		-4.01	
MB	0.009		0.011	
	1.13		1.32	
litigation	13.496	**	13.033	**
	13.45		12.78	
CFO_TA	19.767	*	21.855	*
	2.27		2.47	
Leverage	0.001		-0.002	
	0.05		-0.16	
RoA	19.067		18.605	
	1.97		1.96	
Loss	6.119	**	4.978	**
	4.53		4.05	
increase	2.246		2.138	
	1.83		1.81	
Intercept	95.513	**	92.544	**
	10.51		10.05	
Number of observations	7233		7233	
Adjusted R-squared	0.03		0.03	

Notes: This table contains regression results for testing the association between the probability to issue a management guidance and the cheap talk index over the periods 2006-2022. MVE shows the log of the market value of equity of a firm. MB is the market to book ratio of firm's equity. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CVO TA expresses the cash flow of operations divided by total asset. Leverage is the relationship of debt to book value of equity. RoA is the relationship of net income to total assets. Loss is a dummy of one in case the net income is negative. Increase is a dummy of one in case the net income increased over the last period. Prob is a dummy of one in case of disclosing a management guidance. Herein, $*p < 0.05$; $**p < 0.01$.

monitoring level within large firms reduces greenwashing measures (Hail et al., 2021). If we interpret greenwashing as a measure to explain and manage earnings, we find similar findings as Ali and Zhang (2015), who show negative association between size and management of earnings. In line with Bingler et al. (2024) we do not identify a significant relationship between market to book ratio, leverage, return on assets and the cheap talk index. Additionally, higher exposure to litigation risk is positively associated with the cheap talk index.

Table 4 displays the results of the panel regression related to Hypothesis 2, which examines the association between management earnings forecast accuracy and climate-related cheap talk within firms' annual reports. Column full data presents the regression results without distinguishing the data sample between positive and negative management guidance errors. Column downside (surprise) shows the results of the same regression being applied to firm-year observations with negative (positive) management guidance error, only.

When analyzing the full dataset without differentiating between positive or negative management earnings forecast errors, we do not reveal significant associations between management guidance accuracy and the cheap talk index. However, when examining solely the negative management guidance errors, we find a significantly negative association with a higher cheap talk index, whereas this is not observed for positive errors. These results imply that firms engage more in climate-related cheap talk (greenwashing) by increasing the publication of non-specific climate related disclosure when the management guidance error is negative. This suggests that companies strategically use climate-related cheap talk in an attempt to explain and mitigate the effects of negative deviations from their own disclosed earnings predic-

Table 4: CTI & Guidance accuracy

	Control		Full Data		Downside		Surprise	
AccuracyEPS			0.477					
			1.39					
error					-1.112	**	-0.778	
					-3.60		-1.86	
MVE	-2.164	**	-2.226	**	-1.977	*	-2.744	**
	-4.97		-5.12		-2.85		-6.80	
MB	0.021		0.021		-0.120		0.037	
	1.87		1.88		-0.74		0.98	
litigation	13.752	**	13.772	**	13.335	**	13.779	**
	9.14		9.17		4.23		8.72	
CFO_TA	42.849	**	42.772	**	32.138		35.657	*
	3.82		3.84		1.79		2.16	
Leverage	-0.072	**	-0.071	**	0.100		-0.118	**
	-3.10		-3.17		1.06		-3.06	
RoA	27.489		29.857		49.220		60.514	*
	1.65		1.84		1.81		2.50	
Loss	0.093		-0.866		-2.871		5.331	
	0.04		-0.36		-0.92		0.96	
increase	0.663		0.626		0.871		1.534	
	0.59		0.55		0.82		0.72	
Timedelta	0.009	**	0.007	*	0.010		0.005	
	3.35		2.28		1.43		1.27	
Intercept	96.068	**	97.120	**	92.124	**	106.205	**
	9.84		9.94		5.90		11.42	
Number of observations	4080		4080		1861		2219	
Adjusted R-squared	0.03		0.03		0.03		0.04	

Notes: This table contains regression results for influence of the accuracy of management earnings forecasts on the cheap talk index over the periods 2006-2022. The single columns show the results testing hypothesis 2 depending on the considered data sample. Column downside (surprise) shows the results by considering only firm-year observations with negative (positive) guidance error. MVE shows the log of the market value of equity of a firm. MB is the market to book ratio of firm's equity. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CVO TA expresses the cash flow of operations divided by total asset. Leverage is the relationship of debt to book value of equity. RoA is the relationship of net income to total assets. Loss is a dummy of one in case the net income is negative. Increase is a dummy of one in case the net income increased over the last period. Timedelta represents the timely difference in days between the forecast disclosure and the actual earnings publication. AccuracyEPS (absolute number) and error (considering the signs of the difference between actual and forecast earnings) is calculated by subtracting the EPS of the management earnings forecast from the actual EPS. Herein, * $p < 0.05$; ** $p < 0.01$.

tions (Baginski et al., 2004; Hope et al., 2023; Waymire, 1985). In the case of a positive management earnings forecast error (column surprise) this relation is also present, although the coefficient is weaker and statistically significant only at a 10% level. In contrast to Bingler et al. (2024), we find a significant, but small negative effect of leverage on the cheap talk index. However, the calculation of the leverage variable differs, as Bingler et al. (2024) set total liabilities in relation to total assets instead of book value of equity. We argue that a higher leverage level is associated with stronger monitoring of the firm reducing greenwashing practices. The other control variables are in line with prior literature. Based on these results, we find partial support for hypothesis 2, particularly in the context of underperforming firms (negative forecast errors).

6 Additional analysis and robustness checks

In this section, we conduct additional analyses to enhance the understanding of our results and to verify the robustness of our results.

To further investigate the association between management guidance error and cheap talk index, we analyze the effect size of the management guidance error on the cheap talk index. We repeat the regression for testing hypothesis 2, using management guidance error in 10-decile ranks as the main independent variable. Table 5 indicates that a greater shortfall relative to the guidance corresponds with increased climate-related cheap talk in the annual reports.

To gain a more nuanced understanding of the determinants of climate-related cheap talk, we examine the relationship between CEO characteristics and our variable "cheap talk index". Following prior literature, stakeholders reward a good

Table 5: CTI & effect size of guidance error

	effect size	Accuracy
qACCerror	-0.738	**
	-4.70	
MVE	-2.231	**
	-5.23	
MB	0.019	
	1.72	
litigation	13.660	**
	8.88	
CFO_TA	41.140	**
	3.75	
Leverage	-0.069	**
	-3.15	
RoA	39.469	*
	2.24	
Loss	-0.568	
	-0.23	
increase	1.678	
	1.63	
Timedelta	0.009	**
	3.45	
Intercept	99.597	**
	10.38	
Number of observations	4080	
Adjusted R-squared	0.03	

Notes: This table contains regression results for testing the effect of the size of the management earnings forecast error on the cheap talk index. The table shows the higher the forecast error the higher the cheap talk index. Therefore, a firm with a more inaccurate forecast may explain the negative deviation with more climate-related "cheap talk" within the annual report. qACCerror shows the level of management guidance errors in 10-decil ranks. MVE shows the log of the market value of equity of a firm. MB is the market to book ratio of firm's equity. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CVO TA expresses the cash flow of operations divided by total asset. Leverage is the relationship of debt to book value of equity. RoA is the relationship of net income to total assets. Loss is a dummy of one in case the net income is negative. Increase is a dummy of one in case the net income increased over the last period. Timedelta represents the timely difference in days between the forecast disclosure and the actual earnings publication. Herein, $*p < 0.05$; $**p < 0.01$.

sustainability performance (lower cost of equity capital (El Ghouli et al., 2011), increased future sales (Lev et al., 2010)). However, agency theory postulates that CEOs can create conflicts of interest and take adverse decisions for the shareholders by neglecting investments in CSR activities (Sajko et al., 2021). Bebchuk and Fried (2006) demonstrate that this effect is even more pronounced when the CEO wields greater power within the firm (more opportunities for opportunistic behavior). Velte (2020) claims a lack of research analyzing the impact of CEO characteristics on a firm's CSR. However, the characteristics, experiences and qualifications of the CEO as main decision maker significantly influence the strategies and actions of a firm (Hambrick and Mason, 1984). The market's assessment of CEO capabilities is based on the past performance (Ali and Zhang, 2015). This pertains not only to financial performance but also to sustainability performance. Yuan et al. (2019) show a positive association of a firm's sustainability performance and CEO ability. In the case of a new CEO, it is challenging to assess qualifications based on past performance (Gibbons and Murphy, 1992). Therefore, Ali and Zhang (2015) conclude that new CEOs have incentives to manage and overstate their financial earnings.

Additionally, Hart (1995) shows that the CEO tenure is positively associated with CSR activities. The reliance on stakeholder demands and the knowledge of firm specifics increases with the years of employment as CEO. Consequently, the tenure and other characteristics and experiences of a CEO may increase greenwashing behavior, similar as earnings management (Ali and Zhang, 2015). Chen and Dagestani (2023) empirically tested the effect of several board characteristics on greenwashing in China. The authors show female directors, age diversity of the board and an higher educational level of the directors reduce the engagement in

Table 6: CTI & Details CEO characteristics/experiences

	age		gender		addcomp		tenure		affiliation	
age	6.974									
	1.16									
Sex			4.402 *							
			2.82							
AddComp					-0.841 **					
					-3.76					
Tenure_years							0.279 **			
							5.58			
Affiliation_years									-0.009	
									-0.24	
MVE	-1.917	**	-1.893	**	-3.030	**	-1.774	**	-1.892	**
	-4.74		-4.63		-5.27		-4.22		-4.82	
MB	0.009		0.009		0.011		0.009		0.009	
	1.14		1.14		1.36		1.13		1.13	
litigation	13.564	**	13.379	**	13.152	**	13.593	**	13.490	**
	13.50		13.47		13.49		14.12		13.65	
CFO_TA	19.844	*	19.883	*	25.402	**	20.236	*	19.754	*
	2.27		2.27		2.95		2.34		2.26	
Leverage	0.001		0.001		-0.003		0.002		0.001	
	0.05		0.05		-0.20		0.14		0.05	
RoA	19.137		18.754		20.523		18.465		19.076	
	1.98		1.94		2.08		1.92		1.97	
Loss	6.161	**	6.125	**	5.722	**	6.539	**	6.113	**
	4.58		4.57		3.97		4.81		4.51	
increase	2.260		2.247		2.242		2.323		2.240	
	1.84		1.82		1.83		1.89		1.83	
Intercept	91.716	**	91.006	**	123.808	**	90.549	**	95.247	**
	10.61		9.18		8.95		9.34		10.73	
Number of observations	7233		7233		7233		7233		7233	
Adjusted R-squared	0.03		0.03		0.03		0.03		0.03	

Notes: This table contains regression results for the association between CEO characteristics and experiences and the cheap talk index over the periods 2006-2022. MVE shows the log of the market value of equity of a firm. MB is the market to book ratio of firm's equity. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CVO TA expresses the cash flow of operations divided by total asset. Leverage is the relationship of debt to book value of equity. RoA is the relationship of net income to total assets. Loss is a dummy of one in case the net income is negative. Increase is a dummy of one in case the net income increased over the last period. The table also show the age and the sex of the CEO, whereas sex is a dummy of one in case the CEO is male and age represents the age of the CEO/100. AddComp shows the level of add-on competency of the CEOs in 10-decil ranks. Affiliation and Tenure express the years of a CEO working before becoming CEO and working as a CEO. Herein, $*p < 0.05$; $**p < 0.01$.

green washing activities. They measure greenwashing as the discrepancy between Bloomberg’s ESG disclosure score and the ASSET4 ESG real performance score. The findings of Chen and Dagestani (2023) support the research of Hart (1995), showing a positive association between CEO education and CSR actual activities, as well as Reimer et al. (2018), who analyze the impact of CEO experience on CSR.

In table 6, we reveal significantly positive associations between gender and tenure and the cheap talk index. These results suggest that firms with male CEOs are more likely to engage in climate-related cheap talk compared to female CEOs, which aligns with Chen and Dagestani (2023). However, these results should be interpreted with caution due to the skewed distribution of our sample, where approximately 95% of the CEOs are male. Interestingly, a longer CEO tenure is positively associated with the extend of climate related cheap talk, although the earnings management literature documents stronger earnings overstatement in the CEO’s early tenure years (Ali and Zhang, 2015). This finding may be explained by the positive relationship between CEO tenure and managerial power, which creates more opportunities for opportunistic behavior (Bebchuk and Fried, 2006; Dikolli and William, 2014). Furthermore, we find a negative association of the cheap talk index and the CEO’s add-on competency level, as proxied by unexplained compensation (Eisenhut et al., 2025). This finding aligns with prior literature indicating a positive relationship between CEO ability and sustainability performance (Yuan et al., 2019).

In addition to CEO characteristics, prior literature finds positive associations between the ESG score and the greenwashing behavior of a firm (Kathan et al., 2025). Due to lack of data, we include the ESG scores in our models as control variable for robustness checks (we loose 1,632 firm-year observations). The results

show that our findings are robust and the interpretation of our main variables remain unchanged. Furthermore, we confirm Kathan et al. (2025) who show that a higher ESG score is associated with higher greenwashing risk, as ESG scores may partially capture firms' greenwashing behavior.

To address further correlations and endogeneity concerns within our regression models, table A1 presents the cross-correlation matrix of our main variables in the appendix.

Finally, we validate the climate-related cheap talk variable by following the methodology of Zhang (2023b). We conduct a fixed-effects regression between climate-related cheap talk index and ESG controversy scores, which represent negative ESG-related events and penalties for the company. We find a significant negative correlation, supporting the construct validity of our variable. However, both proxies may measure different aspects of environmentally related information.

7 Conclusion

This study provides empirical evidence regarding the relationship between management earnings forecasts (disclosure likelihood and precision) and climate-related cheap talk (exaggerating greenwashing behavior) within the annual reports of U.S. firms. The quality of disclosure is crucial for capital market participants, as it enhances firm valuations and improves forecast models. However, firms may seek to enhance their legitimacy and signal positive environmental developments through greenwashing methods, which can mislead external stakeholders about the true environmental efforts made (Berrone et al., 2017; Zhang, 2021).

Our findings reveal that firms with a lower probability of disclosing earnings guidance tend to exhibit higher levels of greenwashing. Greenwashing may stem from nontransparent business processes that arise from avoiding high-commitment, verifiable form of financial disclosure throughout the financial year (information transparency) (Wei, 2023). Second, firms are more likely to engage in greenwashing when they fail to meet their own earnings guidance, with the extent of cheap talk increasing alongside the magnitude of the forecast error. These findings align with Epure (2022), which indicates that firms exhibit higher greenwashing behavior to mitigate financial distress. Firms seem to rationalize negative management earnings forecast errors, which come along with possible market penalization (Hope et al., 2023; Waymire, 1985). Additionally, we corroborate the findings of Baginski et al. (2004), which suggest that firms tend to explain bad news forecasts with supplementary attributions accompanying the guidance.

To gain a deeper understanding of the determinants of climate-related cheap talk, we examine the relationship of CEO characteristics and non-specific climate-related actions and commitments. Our results indicate that male CEOs and those with lower add-on competencies are more prone to non-specific climate-related disclosures, although sample limitations must be considered. Furthermore, CEO tenure shows a positive correlation with greenwashing tendencies. We also confirm the findings of (Kathan et al., 2025), who demonstrate that higher ESG scores are associated with increased greenwashing risk, as ESG scores may partially capture firms' greenwashing behavior.

Despite potential limitation (e.g. the indirect observability of greenwashing strategies) this research enhance the understanding of how financial performance

and disclosure strategies interact in shaping climate-related communication. First, we provide a comprehensive analysis of the association between management guidance and climate-related cheap talk. In addition to examining the probability of management guidance disclosure, our analysis of the management earnings forecast errors elucidates the relationships of greenwashing and management guidance. Second, in contrast to prior literature, we assess disclosure quality using a sophisticated text analysis tool trained with a deep learning approach. This methodology allows an identification of explanatory narratives within annual reports, beyond capturing subtle linguistic cues and contextual nuances indicative of greenwashing. Third, we enhance the understanding of cheap talk measurement by incorporating CEO characteristics and ESG scores in a further analysis. This allows a more nuanced interpretation of sustainability communication within firms. While annual reports, particularly MD&A sections, seem to serve as channels through which firms provide explanatory narratives and reallocate attention (information content of MD&A section increases after major negative news (Liu et al., 2025)), other channels may also explain less accurate management earnings forecasts through greenwashing behavior. Future research may elaborate on similar relationships within, e.g., conference and earnings calls to acknowledge the different channels of information distribution (Beyer et al., 2010). Furthermore, researchers may examine the relationship of the greenwashing strategies distracting (cover bad news with positive news) and window-dressing (confuse public with irrelevant activities) with management earnings forecasts.

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8 Appendix

Table A1 shows the cross-correlation matrix of the factors used in the regressions to test our hypotheses

Table A1: Cross-correlation

Variables	CTI	Prob	Acc	age	Sex	AddComp	Affiliation	Tenure	MVE	MB	litigation	CFO_TA	Leverage	RoA	Loss	increase	Timedelta
CTI	1.000																
Prob	-0.103	1.000															
AccuracyEPS	0.023	.	1.000														
age	0.018	-0.007	-0.007	1.000													
Sex	0.024	-0.047	-0.027	0.020	1.000												
AddComp	0.018	-0.021	-0.088	-0.025	0.005	1.000											
Affiliation_years	-0.030	0.070	-0.011	0.083	-0.009	-0.031	1.000										
Tenure_years	0.050	-0.019	-0.035	0.411	0.074	0.004	-0.112	1.000									
MVE	-0.047	0.192	-0.006	0.054	-0.034	-0.650	0.268	-0.092	1.000								
MB	0.013	0.017	-0.016	0.001	-0.006	-0.006	0.004	-0.005	0.023	1.000							
litigation	0.133	-0.050	0.004	-0.050	0.038	-0.046	-0.020	-0.023	0.025	0.008	1.000						
CFO_TA	0.027	0.116	-0.085	-0.022	0.010	0.015	0.066	-0.015	0.231	0.012	0.094	1.000					
Leverage	0.002	-0.018	-0.006	0.003	-0.004	-0.037	-0.004	-0.017	0.001	0.472	-0.011	-0.041	1.000				
RoA	0.016	0.139	-0.242	0.002	0.016	-0.043	0.087	0.021	0.286	0.019	0.036	0.530	-0.036	1.000			
Loss	0.047	-0.187	0.306	-0.026	-0.007	0.064	-0.092	-0.053	-0.259	-0.004	0.026	-0.262	0.014	-0.588	1.000		
increase	0.029	0.011	-0.058	-0.016	0.008	0.017	-0.017	-0.007	0.025	0.021	0.014	0.078	0.016	0.235	-0.185	1.000	
Timedelta	0.031	.	0.204	-0.014	-0.010	0.034	-0.011	-0.022	-0.102	-0.028	-0.025	0.068	-0.014	-0.045	0.088	0.021	1.000

Notes: This table contains cross-correlation of variables used in regression analyses. CTI represents the cheap talk index between 0 and 100. Acc is calculated by subtracting the EPS of the management earnings forecast from the actual EPS. Prob is a dummy of one in case of disclosing a management guidance. The table also show the age and the sex of the CEO, whereas sex is a dummy of one in case the CEO is male and age represents the age of the CEO/100. AddComp shows the level of add-on competency of the CEOs in 10-decil ranks. Affiliation and Tenure express the years of a CEO working before becoming CEO and working as a CEO. MVE shows the log of the market value of equity of a firm. MB is the market to book ratio of firm's equity. Litigation is a dummy of one in case the firm is acting in the industries with a SIC code 833-2836, 3570-3577, 7370-7374, 3600-3674. The variable CVO TA expresses the cash flow of operations divided by total asset. Leverage is the relationship of debt to book value of equity. RoA is the relationship of net income to total assets. Loss is a dummy of one in case the net income is negative. Increase is a dummy of one in case the net income increased over the last period. Timedelta represents the timely difference in days between the forecast disclosure and the actual earnings publication.