

Greenwashing: Measurement and Implications

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SUSTAINABLE BUSINESS

Global Executives Say Greenwashing Remains Rife

Nearly three-quarters of corporate leaders say most organizations in their industry would be caught greenwashing if they were investigated thoroughly

By *Rochelle Toplensky*

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Motivation

▶ What is Greenwashing?

- ▶ Misleading publicity or propaganda disseminated by an organization, etc., so as to present an environmentally responsible public image - *Oxford English Dictionary*
- ▶ Greenwashing firms are those with poor actual environmental performance but communicate their environmental efforts positively (Delmas and Burbano, 2011).
- ▶ **Greenwashing can be defined as the discrepancy between green talk and actual green walk** (e.g., Walker and Wan, 2012; Pizzetti, Gatti, and Seele, 2021).

Motivation

- ▶ As companies increasingly tout their environmentally friendly commitments and initiatives, a pressing concern has emerged regarding the authenticity of their claims.
- ▶ **In this paper, we leverage a finance-specialized machine learning technique to measure greenwashing behaviors for a broad sample of U.S. firms.**
 - ▶ Product-Level Greenwashing **X**
 - ▶ Misrepresent the environmental benefits of a product or service.
 - ▶ **Corporate Greenwashing** **✓** → focus of the paper
 - ▶ Firms' talks \neq firms' walks.
 - ▶ We construct a firm-level greenwashing measure that captures the distance between a firm's green talks and its actual environmental performance.

How Do We Measure Corporate Greenwashing (Green Talks & Green Walks) ?

1. Green Talks

- 1. We use earnings conference call transcripts as text data to capture corporate green talks.**
 - ▶ Earnings conference calls generally take place quarterly after a publicly traded firm releases its financial results for the previous quarter.
 - ▶ It provides a forum for a firm to update investors on its financial performance and outlook, and for investors to ask follow-up questions.
 - ▶ Due to the high volume of firm-level information, recent literature uses earnings conference call transcripts to measure a firm's exposure to different aspects, such as political risk (Hassan et al.,2019) and climate change (Li et al.,2022; Sautner et al.,2023).
- 2. We split each earnings call transcript into sentences.**
- 3. We employ a machine learning model, FinBERT (Huang, Wang, and Yang, 2023), to identify whether a sentence is green talk or not.**

1.1 How to Identify Green Talks

1. Prior studies generally use keyword lists to identify climate sentences:

- ▶ Li et al. (2024-RFS) construct a climate disaster dictionary from sources such as Wikipedia list of severe weather phenomena.
- ▶ Sautner et al. (2024-JF) adopt a keyword discovery machine learning approach to expand the climate-related keyword list.

1.1 How to Identify Green Talks - Cont.

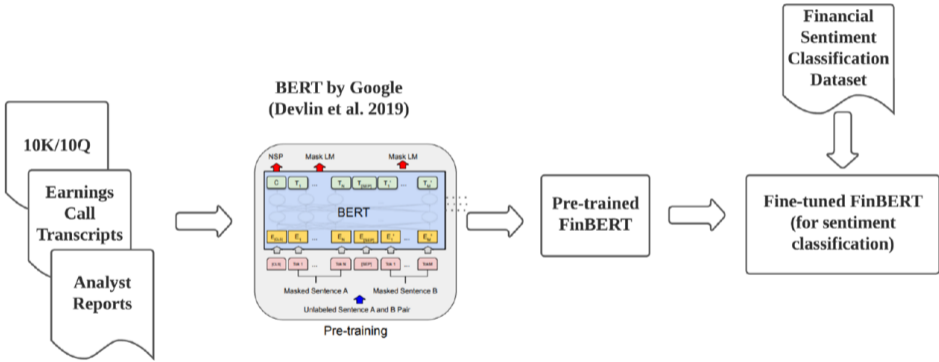
2. Relying on a climate keyword list to capture green talks can be particularly challenging:

- ▶ The green talks we want to capture are those climate discussions from the corporate executives that tout their firms' environmental investments, efforts, and performance.
- ▶ As such, identifying green talks should depend on a sentence's context. However, the **keyword approach is context-independent**, implying that any sentence containing climate-related words will be classified as green talks, irrespective of its actual context.
 - ▶ *"The weaker wind resource was the primary driver of the negative \$0.04 contribution from existing wind assets relative to the prior year comparable quarter"*
 - By the CEO of NextEra Energy Inc in 2011Q4 earnings conference call.

1.2 Why FinBERT

3. **In this study, we use FinBERT, a BERT-based model, to measure a firm's green talks.**
 - ▶ BERT is a deep-learning-based large language model (Devlin et al., 2018), pretrained using around 2.5 billion words from Wikipedia and 800 million words from Google's BooksCorpus.
 - ▶ For instance, BERT can understand that the word “climate” has different meanings in the sentences “*We have a very good business **climate***” and “*Our company cares about **climate** change*”.
 - ▶ FinBERT is further trained based on BERT using a large amount of financial text(e.g.,10K filings) as training data. Recent studies show that FinBERT works better than BERT in financial context.

1.2 Why FinBERT - Cont.



1.3 A Sample of Climate-related Sentences for Model Fine Tuning

3. **Manually classify 3,500 climate-related sentences - each contain at least one climate-related keyword (keyword lists from Sautner et. al. 2023)**
 - ▶ 1,230 are green talks
 - ▶ 2,270 are non-green talks
 - ▶ We use 90% of them as training sample and 10% as testing sample.

Examples of Green-talk-related Sentence	Green Talks?
1. We're excited about the progress that we're making to combat climate change and enable a cleaner, more sustainable world.	✓
2. The weaker wind resource was the primary driver of the negative \$0.04 contribution from existing wind assets relative to the prior year comparable quarter.	✗

1.4 Model Testing Performance

	Precision	Recall	F1-score	# Sentence
Negative	0.93	0.92	0.92	227
Positive	0.85	0.88	0.86	123
Overall Accuracy			0.90	350
Macro Average	0.89	0.90	0.89	350
Weighted Average	0.90	0.90	0.90	350

1.5 Green Talk Intensity

$$\text{Green Talk Intensity}_{i,t} = \frac{\text{Average number of green talk sentences}_{i,t}}{\text{Average number of total sentences}_{i,t}} \quad (1)$$

1. Measured as the average number of green talk sentences (predicted by our fine-tuned FinBERT) divided by the average number of total sentences in the earnings conference call transcripts for that firm in that year.
2. If a firm does not talk itself green in a year (i.e., *Average number of green talk sentences* equals 0), we replace its Green Talk Intensity as missing.

2. Green Walks

1. We employ **RepRisk incidents** as a metric to measure the actual environmental performance (Green Walk) of a firm.
 - ▶ Unlike other ESG rating datasets, RepRisk identifies event-level risk incidents for firms from over 100,000 media sources in 23 languages on a daily basis.
2. We count the number of environmental incidents in each firm-year and **rank the sample firms into percentiles each year based on the environmental incident count**. We further multiply the incident count percentile by -1 so that a lower value indicates worse actual environmental performance of a firm.

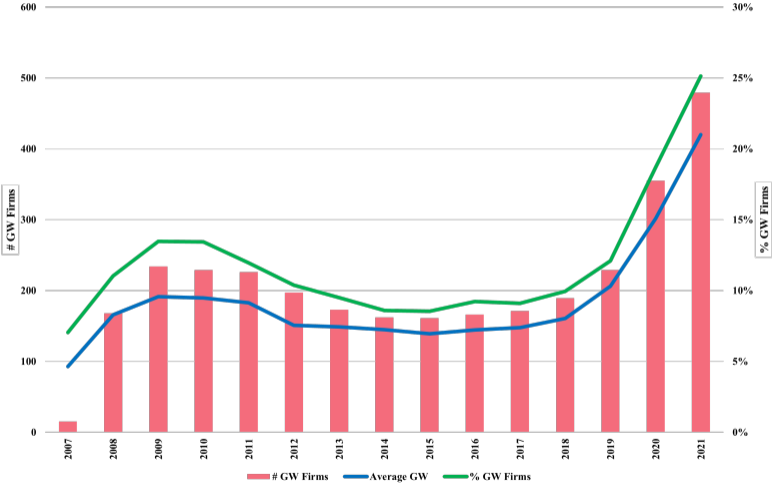
3. Greenwashing Measure: Green Talks - Green Walks

$$GW_{i,t} = \frac{Rank_{i,t}^{GreenTalk} - Rank_{i,t}^{EnvIncidents}}{100} \quad (2)$$

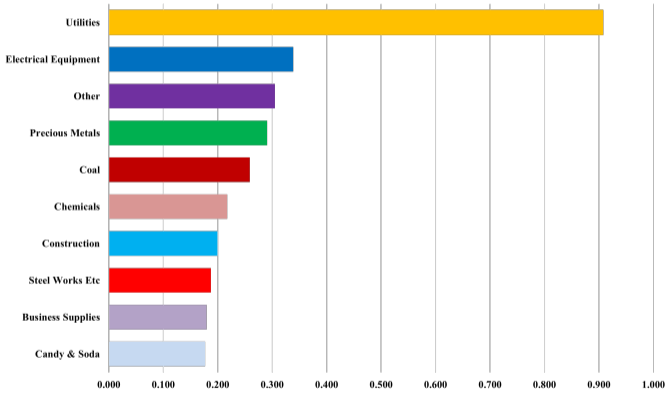
1. If a firm does not have any green talk in a year, we replace the missing GW value by 0.
2. The value of GW ranges from 0 to 2, where 0 indicates non-greenwashing firms and 2 indicates intensive greenwashing firms.

Validation Tests

Annual Variation of GW

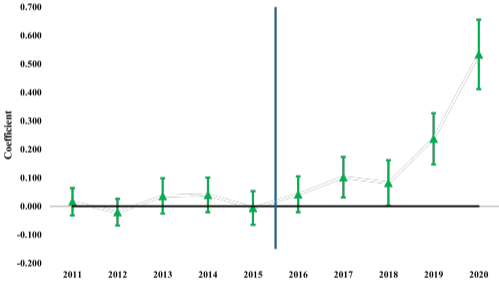


Top-10 Industries (FF48) by Avg. GW

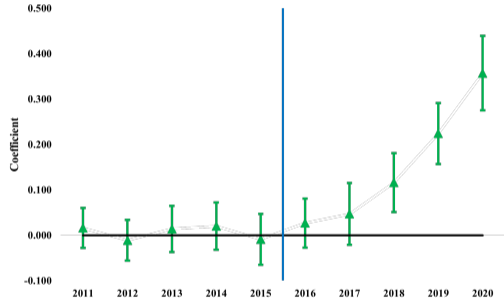


GW is most prevalent in Utilities sector.

The Effect of the 2015 Paris Agreement on Corporate GW



Firms in Fossil Fuel Industry vs. Firms in Other Industries



Firms in Stranded Asset Industries vs. Firms in Other Industries

GW, Environmental Incidents, EPA Enforcement Actions, and CO2 Emissions

VARIABLES	(1) # Env Incident $t+1$	(2) # Env Incident $t+1$	(3) # Env Incident $t+1$	(4) # Env Incident $t+1$
GW	0.250*** (0.073)	0.298*** (0.087)	0.105*** (0.013)	0.131*** (0.013)
Model	Poisson	Poisson	OLS	OLS
Industry FE	✓		✓	
Year FE	✓		✓	
Industry-Year FE		✓		✓
Obs.	27,024	25,533	30,364	30,364
Pseudo R2/Adj. R2	0.694	0.708	0.299	0.328

GW is associated with more and higher likelihood of environmental incidents in the subsequent year.

GW, Environmental Incidents, EPA Enforcement Actions, and CO2 Emissions - Cont.

VARIABLES	(1) # Formal Enforcements $t+1$	(2) # Formal Enforcements $t+1$	(3) # Informal Enforcements $t+1$	(4) # Informal Enforcements $t+1$
GW	0.245*** (0.093)	0.267*** (0.099)	0.162** (0.075)	0.157* (0.080)
Model	Poisson	Poisson	Poisson	Poisson
Industry FE	✓		✓	
Year FE	✓		✓	
Industry-Year FE		✓		✓
Obs.	26,826	18,419	26,485	23,029
Pseudo R2	0.283	0.256	0.269	0.264

GW is associated with more formal/informal environmental enforcements in the subsequent year.

GW, Environmental Incidents, EPA Enforcement Actions, and CO2 Emissions - Cont.

VARIABLES	(1) Raw CO2 Emissions $t+1$	(2) Raw CO2 Emissions $t+1$	(3) CO2 Emissions Intensity $t+1$	(4) CO2 Emissions Intensity $t+1$
GW	0.326*** (0.087)	0.342*** (0.091)	0.522*** (0.079)	0.529*** (0.080)
Model	Poisson	Poisson	Poisson	Poisson
Industry FE	✓		✓	
Year FE	✓		✓	
Industry-Year FE		✓		✓
Obs.	13,735	13,726	13,735	13,726
Pseudo R2	0.848	0.860	0.534	0.543

GW is associated with larger CO2 emissions quantities and higher CO2 emissions intensity in the subsequent year.

GW and Green Patents Developments

VARIABLES	(1) # Green Patent	(2) $_{t+1,t+3}$	(3) # Green Patent Citations	(4) $_{t+1,t+3}$
GW	0.084 (0.176)	0.155 (0.234)	0.107 (0.195)	0.172 (0.223)
Model	Poisson	Poisson	Poisson	Poisson
Industry FE	✓		✓	
Year FE	✓		✓	
Industry-Year FE		✓		✓
Obs.	26,206	22,370	23,505	19,659
Pseudo R2	0.519	0.518	0.486	0.505

There is no indication of an increase in green innovation for GW firms.

Implications for Firms

Stock Price Reaction to GW

VARIABLES	(1)	(2)	(3)	(4)	(5)
	CAR (0, 4)				
GW^Q	-0.003***	-0.004***	-0.003***	-0.003**	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Industry FE				✓	
Year-Quarter FE			✓	✓	
Industry-Year-Quarter FE					✓
Obs.	107,464	107,464	107,464	107,464	107,464
Adj. R2	0.000	0.171	0.200	0.200	0.217

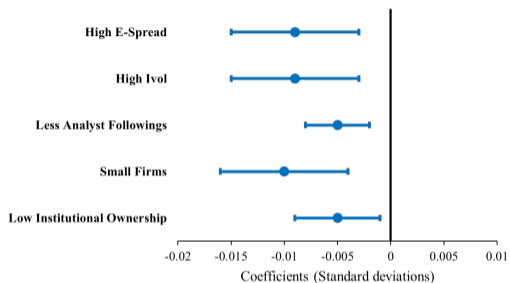
Investors react significantly negative to firms' greenwashing behaviors.

GW and Future Operating Performance

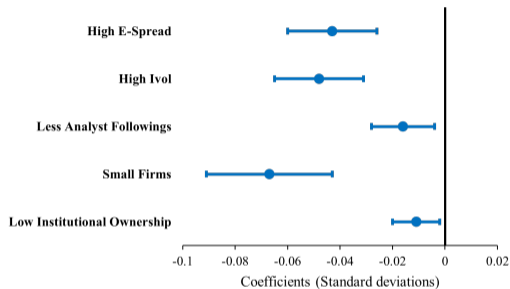
VARIABLES	(1)	(2)	(3)	(4)
	ROA _{t+1}		OCF _{t+1}	
GW	-0.024***	-0.029***	-0.014***	-0.019***
	(0.004)	(0.004)	(0.002)	(0.003)
Firm Controls	✓	✓	✓	✓
Industry FE	✓		✓	
Year FE	✓		✓	
Industry-Year FE		✓		✓
Obs.	30,364	30,364	27,145	27,145
Adj. R2	0.389	0.403	0.569	0.577

GW firms have worse future operating performance.

GW and Future Operating Performance - Cont



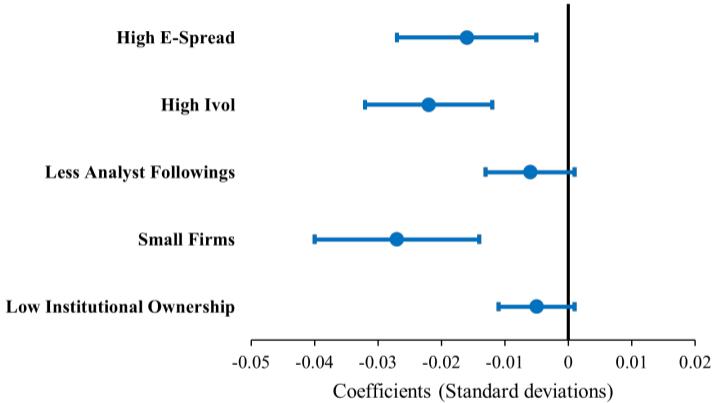
CAR



ROA

The negative relationships are more pronounced for firms with higher information asymmetry and less institutional monitoring.

GW and Future Operating Performance - Cont



OCF

Why Firms Greenwash?

External Environmental Rating

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Refinitive Env Score $t+1$	KLD Env Score $t+1$	KLD Env Score $t+1$	KLD Env Score $t+1$	Sustainalytics Env Score $t+1$	Sustainalytics Env Score $t+1$
GW	8.202***	8.033***	0.102**	0.088*	2.611***	2.682***
	(1.057)	(1.124)	(0.051)	(0.051)	(0.689)	(0.727)
Firm Controls	✓	✓	✓	✓	✓	✓
Industry FE	✓		✓		✓	
Year FE	✓		✓		✓	
Industry-Year FE		✓		✓		✓
Obs.	16,544	16,519	17,585	17,580	7,384	7,367
Adj. R2	0.515	0.522	0.259	0.295	0.393	0.380

GW firms receive higher external environmental ratings.

CEO Incentives

VARIABLES	(1)	(2)	(3)
	1 (Forced Turnover) $t+1$		
GW	0.000	0.007	0.009
	(0.004)	(0.006)	(0.006)
GW × Post₂₀₁₅		-0.018**	-0.020**
		(0.007)	(0.008)
GW × Ind-adj. ROA			-0.110
			(0.080)
Ind-adj. ROA × Post ₂₀₁₅			0.011
			(0.025)
GW × Ind-adj. ROA × Post₂₀₁₅			0.162*
			(0.092)
Firm & CEO Controls	✓	✓	✓
Industry-Year FE	✓	✓	✓
Obs.	17,943	17,943	17,943
Adj. R2	0.011	0.011	0.011

CEOs of GW firms are less likely to get forced turnover, and the forced-turnover-to-operating-performance sensitivity is also lower, indicating higher job security.

CEO Incentives - Cont.

VARIABLES	(1) Delta t_{+1}	(2)	(3) Vega t_{+1}	(4)	(5) 1 (E Pay) t_{+1}	(6)	(7) E Pay Intensity t_{+1}	(8)
GW	-0.123** (0.060)	-0.093 (0.063)	-0.250* (0.151)	-0.126 (0.158)	0.069*** (0.017)	0.066*** (0.024)	0.005*** (0.001)	0.002** (0.001)
GW × Post_2015		-0.170 (0.129)		-0.704*** (0.231)		0.007 (0.030)		0.005*** (0.002)
Firm & CEO Controls	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Obs.	11,149	11,149	11,146	11,146	18,292	18,292	18,292	18,292
Adj. R2	0.526	0.526	0.249	0.250	0.131	0.131	0.217	0.220

CEO compensation is less sensitive to corporate operating performance and more closely linked to corporate environmental performance, incentivizing executives to engage in greenwashing.

CEO Incentives - Cont.

VARIABLES	(1) CAPEX _{t+1}	(2) R&D _{t+1}	(3) Acquisition Expense _{t+1}	(4) Total Investment _{t+1}	(5) Leverage _{t+1}	(6) Cash Holdings _{t+1}
GW	0.001 (0.002)	-0.004** (0.002)	-0.004*** (0.001)	-0.004*** (0.001)	-0.025*** (0.006)	0.009*** (0.003)
Industry-Year FE	✓	✓	✓	✓	✓	✓
Obs.	30,136	30,364	28,880	28,856	30,364	29,943
Adj. R2	0.422	0.576	0.072	0.620	0.283	0.423

CEOs' of GW firms reduce their risk-taking activities, enjoying a quite life.

Conclusion

- ▶ In this paper, we match the corporate green talks identified by the FinBERT model with the actual corporate environmental incidents from RepRisk to construct a comprehensive measure of firm-level greenwashing intensity.
- ▶ We conduct various tests to validate our firm-level greenwashing measure.
 1. Essentially, we find that firms with higher greenwashing intensity incur greater amount of future environmental incidents and experience higher amount of future EPA enforcement actions.
 2. While greenwashing firms do not produce more green innovations in the future.

Conclusion - Cont.

- ▶ We further investigate the implications of the firm-level greenwashing measure.
 1. Greenwashing firms are associated with lower CAR following earnings conference calls and lower future corporate operating performance. These effects are concentrated on firms with greater information asymmetry and weaker institutional monitoring.
 2. Greenwashing firms receive higher external environmental ratings.
 3. CEOs of Greenwashing firms earn higher job security after the Paris Agreement. Their pay-for-performance sensitivity is lower, and their pay is more likely to link with corporate environmental performance.