Appendix B: Robustness of environmental disclosures

We perform several robustness checks to ensure the appropriateness of the proxy of environmental disclosures, i.e., green tweets. First, we evaluate the quality of identifying green tweets. We manually classify a random sample of 1,000 tweets as either environmental or not and compare the manual classification with the automated classification based on different cutoff levels for environmental terms. Tweets meeting or beating the cutoff are classified as green tweets. Environmental terms are identified using the CSR dictionary by Pencle and Mălăescu (2016). Table B.1 provides an overview of the quality of each cutoff level. While a lower cutoff reduces the likelihood of misclassifying green tweets as non-green tweets, a higher cutoff reduces the likelihood of misclassifying non-green tweets as green tweets.

Table B.1

Robustness of green tweets

Cutoff	Precision	Recall	F1 Score	Mean
0	0.12	1.00	0.22	0.56
1	0.28	0.78	0.41	0.53
2	0.53	0.47	0.50	0.50
3	0.72	0.17	0.28	0.45

Note: The table provides an overview of precision, recall, F1 score, and mean of a random sample of 1000 tweets drawn from the total population. The cutoff indicates how many environmental terms a tweet needs to contain to be classified as a green tweet. Precision is calculated as the fraction of true predicted green tweets over total predicted green tweets. Recall is calculated as the fraction of true predicted green tweets over true green tweets. F1 score is the harmonic mean of both measures, mean the arithmetic mean.

For the main analysis, we select a cutoff of one environmental term to ensure a sufficiently high detection of green tweets.

Second, for robustness, we repeat the analysis with cutoff levels of zero, two, and three environmental terms. Tables B.2, B.3, and B.4 report the results of these analyses. The results remain largely robust to the different cutoff levels.

Table B.2 reports the results of the regression investigating whether the relation between environmental performance and voluntary environmental disclosures is moderated by CEO integrity. In Columns (1) to (4), reporting the results for cutoff levels of two and three environmental terms, the coefficient on *Pollution* is only weakly significant. This loss in significance can be attributed to the lower number of tweets being classified as green tweets, reducing the size of the coefficient on *Pollution*. The interaction term remains highly significant for the most part. The coefficients are no longer significant in Columns (5) and (6), reporting the results for a cutoff level of zero environmental terms. This result supports that the findings are related to green tweets, not all tweets in general.

Tables B.3 and B.4 report the results of the regression investigating whether the relation between voluntary environmental disclosures and assessed environmental performance is moderated by CEO integrity. Table B.3 investigates investors' assessed performance in terms of abnormal returns. The coefficient on *GreenTweets* gets larger the higher the cutoff level is (Columns (1) and (2) vs. Columns (3) and (4)), as the identification of *GreenTweets* gets more precise. In contrast, when classifying all tweets as green tweets (Columns (5) and (6)), the coefficient on *GreenTweets* gets insignificant. Table B.4 investigates ESG-analysts' assessed performance in terms of rating performance. Again, the coefficient on *GreenTweets* gets larger the higher the cutoff level is (Columns (1) and (2) vs. Columns (3) and (4)), as the identification of *GreenTweets* gets more precise. In contrast, when classifying all tweets as green tweets (Columns (5) and (6)), the coefficient on *GreenTweets* gets very small, as

non-environmental tweets are misclassified as green tweets and therefore dilute the effect.

Third, we analyze tweets' sentiment based on Loughran and McDonald's (2011) dictionary. We calculate a tone measure as the difference between the number of positive and negative words per tweet normalized by the tweet's length (*Tone*). First, we find that green tweets are significantly more positive compared to other tweets (untabulated). Second, we repeat the analysis investigating whether the relation between environmental performance and voluntary environmental disclosures is moderated by CEO integrity (see Model (1)), considering only environmental tweets with a non-negative tone as green tweets. Table B.5 presents the results of this analysis. The regression results remain largely robust to this subsample analysis.

Concluding, the results support the identification of green tweets and are in line with the findings presented in the main analyses.

Table B.2

Regression results: CEO integrity, environmental performance, and voluntary environmental disclosures (robustness green tweets)

Variables	(1) GreenTweets	(2) GreenTweets	(3) GreenTweets	(4) GreenTweets	(5) GreenTweets	(6) GreenTweets
Pollution	0.1324†	0.1324	0.0812†	0.0812†	0.4080	0.4080
	(0.1033)	(0.1235)	(0.0497)	(0.0565)	(0.4005)	(0.9343)
TruthfulCEO	0.5397	0.5397	0.3074*	0.3074	16.7913***	16.7913***
	(0.3396)	(0.6484)	(0.1679)	(0.3028)	(2.0093)	(5.4294)
TruthfulCEO x Pollution	-0.9085***	-0.9085**	-0.3283***	-0.3283†	0.9668	0.9668
	(0.2152)	(0.3917)	(0.1164)	(0.2020)	(1.7467)	(5.1028)
TwitterActivity	0.1031***	0.1031***	0.0299***	0.0299***		
	(0.0097)	(0.0213)	(0.0036)	(0.0070)		
LikesPerTweet	-0.0013	-0.0013	0.0002	0.0002	-0.0193**	-0.0193†
	(0.0016)	(0.0024)	(0.0009)	(0.0013)	(0.0089)	(0.0135)
RepliesPerTweet	-0.0503	-0.0503	-0.0354	-0.0354	-1.0172	-1.0172
	(0.1149)	(0.1485)	(0.0496)	(0.0678)	(0.8940)	(1.5974)
NewCEO	-0.2951	-0.2951	-0.2966*	-0.2966	9.6017***	9.6017
	(0.3458)	(0.6747)	(0.1663)	(0.3199)	(3.2209)	(9.2036)
TenureCEO	0.0033	0.0033	-0.0121	-0.0121	3.2416***	3.2416**
	(0.0411)	(0.0904)	(0.0201)	(0.0405)	(0.5135)	(1.3722)
FirmSize	0.2656†	0.2656	0.0565	0.0565	18.7517***	18.7517***
	(0.1838)	(0.3747)	(0.0856)	(0.1693)	(1.5296)	(3.9568)
SalesGrowth	-6.7896***	-6.7896**	-3.0377***	-3.0377**	-37.8415***	-37.8415
	(1.8468)	(2.7890)	(0.9277)	(1.3053)	(11.4692)	(32.0694)

Table B.2 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
ROA	-0.1112†	-0.1112	-0.0639†	-0.0639	-5.8004***	-5.8004***
	(0.0806)	(0.1545)	(0.0447)	(0.0806)	(0.6355)	(1.7060)
CarbonEmissions	-0.0059***	-0.0059†	-0.0021*	-0.0021	-0.0981***	-0.0981**
	(0.0022)	(0.0040)	(0.0011)	(0.0020)	(0.0146)	(0.0399)
LeverageRatio	6.7562***	6.7562**	2.9832***	2.9832**	-93.6832***	-93.6832**
	(1.3890)	(2.8326)	(0.6413)	(1.2031)	(12.3039)	(36.3933)
MTB	-0.2967**	-0.2967†	-0.0583	-0.0583	8.2049***	8.2049***
	(0.1259)	(0.2250)	(0.0670)	(0.1156)	(1.0835)	(2.9761)
Observations	1,120	1,120	1,120	1,120	1,120	1,120
Adjusted R2	0.604	0.604	0.455	0.455	0.413	0.413
Year & Industry FE	✓	✓	✓	✓	✓	✓
Firm-Year Cluster	✗	✓	✗	✓	✗	✓

Note: The table reports regression coefficients of an OLS regression investigating whether the relation between environmental performance and voluntary environmental disclosures is moderated by CEO integrity (see Model (1)). *GreenTweets* is the monthly number of environmental tweets. Columns (1) and (2) use a cutoff of two environmental terms to identify green tweets. Columns (3) and (4) use a cutoff of three environmental terms to identify green tweets. Columns (5) and (6) use total tweets as a proxy for green tweets. *Pollution* is the relative annual change in corporate carbon emissions. *TruthfulCEO* is a dummy variable indicating whether a CEO is truthful or deceptive. *TwitterActivity* is the total number of tweets less the number of environmental tweets. *LikesPerTweet* and *RepliesPerTweet* are the ratios of likes or replies and the total number of tweets. *NewCEO* is a dummy variable indicating whether the CEO is new in his position. *TenureCEO* is the number of years since the current CEO's starting date. *FirmSize* is the natural logarithm of the firm's total assets. *SalesGrowth* is the firm's relative change in sales. *ROA* is the firm's return on assets. *CarbonEmissions* is the firm's level of carbon emissions in millions. *LeverageRatio* is the ratio of the firm's total liabilities and total assets. *MTB* is the firm's market-to-book ratio. Robust standard errors are reported in parentheses (***$p<0.01$, **$p<0.05$, *$p<0.1$ denote significance based on two-tailed tests; $^{\dagger}p<0.1$ denotes significance based on one-tailed tests). Appendix A provides all variable definitions.

Table B.3

Regression results: CEO integrity, voluntary environmental disclosures, and assessed environmental performance (robustness green tweets)

Variables	(1) $AR_{d,d+3}$	(2) $AR_{d,d+3}$	(3) $AR_{d,d+3}$	(4) $AR_{d,d+3}$	(5) $AR_{d,d+3}$	(6) $AR_{d,d+3}$
GreenTweets	-0.0019**	-0.0019**	-0.0026**	-0.0026***	-0.0002	-0.0002
	(0.0008)	(0.0007)	(0.0011)	(0.0008)	(0.0006)	(0.0005)
TruthfulCEO	-0.0000	-0.0000	0.0001	0.0001	-0.0007	-0.0007
	(0.0010)	(0.0009)	(0.0010)	(0.0009)	(0.0014)	(0.0010)
TruthfulCEO x GreenTweets	0.0016*	0.0016*	0.0032**	0.0032***	0.0006	0.0006
	(0.0009)	(0.0009)	(0.0014)	(0.0011)	(0.0006)	(0.0005)
TwitterActivity	0.0000	0.0000	0.0000	0.0000		
	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
LikesPerTweet	-0.0000	-0.0000†	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
RepliesPerTweet	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
NewCEO	0.0009	0.0009†	0.0009	0.0009†	0.0007	0.0007
	(0.0011)	(0.0007)	(0.0011)	(0.0007)	(0.0011)	(0.0006)
TenureCEO	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001†
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
FirmSize	-0.0008	-0.0008	-0.0009	-0.0009†	-0.0010	-0.0010**
	(0.0009)	(0.0006)	(0.0009)	(0.0006)	(0.0008)	(0.0005)
SalesGrowth	0.0015	0.0015	0.0017	0.0017	0.0025	0.0025
	(0.0077)	(0.0052)	(0.0077)	(0.0051)	(0.0076)	(0.0052)

	(1)	(2)	(3)	(4)	(5)	(6)
ROA	0.0005	0.0005†	0.0006	0.0006†	0.0006	0.0006†
	(0.0006)	(0.0004)	(0.0006)	(0.0004)	(0.0005)	(0.0004)
CarbonEmissions	0.0000	0.0000†	0.0000	0.0000†	0.0000	0.0000†
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LeverageRatio	0.0025	0.0025	0.0025	0.0025	0.0037	0.0037
	(0.0077)	(0.0052)	(0.0078)	(0.0051)	(0.0074)	(0.0047)
MTB	-0.0011†	-0.0011*	-0.0011†	-0.0011*	-0.0012*	-0.0012*
	(0.0007)	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0006)
Pollution	-0.0007	-0.0007	-0.0004	-0.0004	-0.0004	-0.0004
	(0.0042)	(0.0035)	(0.0042)	(0.0035)	(0.0042)	(0.0033)
$AR_{d-30,d}$	0.0692***	0.0692***	0.0691***	0.0691***	0.0687***	0.0687***
	(0.0049)	(0.0041)	(0.0049)	(0.0042)	(0.0049)	(0.0041)
Stock Volatility	-0.1145**	-0.1145*	-0.1129**	-0.1129*	-0.1134**	-0.1134*
	(0.0530)	(0.0611)	(0.0529)	(0.0619)	(0.0530)	(0.0620)
ISVI	0.0031	0.0031	0.0031	0.0031	0.0031	0.0031
	(0.0027)	(0.0025)	(0.0027)	(0.0025)	(0.0026)	(0.0024)
Observations	6,586	6,586	6,586	6,586	6,586	6,586
Adjusted R2	0.0473	0.0473	0.0473	0.0473	0.0481	0.0481
Year & Industry FE	✓	✓	✓	✓	✓	✓
Firm-Year Cluster	✓	✗	✓	✗	✓	✗

Table B.3 (continued)

Note: The table reports regression coefficients of an OLS regression investigating whether the relation between voluntary environmental disclosures and assessed environmental performance is moderated by CEO integrity (see Model (2)). *AR* are the cumulative abnormal returns. *GreenTweets* is the monthly number of environmental tweets. Columns (1) and (2) use a cutoff of two environmental terms to identify green tweets. Columns (3) and (4) use a cutoff of three environmental terms to identify green tweets. Columns (5) and (6) use total tweets as a proxy for green tweets. *TruthfulCEO* is a dummy variable indicating whether a CEO is truthful or deceptive. *TwitterActivity* is the total number of tweets less the number of environmental tweets. *LikesPerTweet* and *RepliesPerTweet* are the ratios of likes or replies and the total number of tweets. *NewCEO* is a dummy variable indicating whether the CEO is new in his position. *TenureCEO* is the number of years since the current CEO's starting date. *FirmSize* is the natural logarithm of the firm's total assets. *SalesGrowth* is the firm's relative change in sales. *ROA* is the firm's return on assets. *CarbonEmissions* is the firm's level of carbon emissions in millions. *LeverageRatio* is the ratio of the firm's total liabilities and total assets. *MTB* is the firm's market-to-book ratio. *Pollution* is the firm's relative change in carbon emissions. $AR_{t-30,t}$ is the firm's abnormal returns over the past 30 days. *StockVolatility* is the average standard deviation of the firm's stock returns over the past 30 days. *ISVI* is the Investor Search Volume Index from Google Trends. Robust standard errors are reported in parentheses (***$p<0.01$, **$p<0.05$, *$p<0.1$ denote significance based on two-tailed tests; †$p<0.1$ denotes significance based on one-tailed tests). Appendix A provides all variable definitions.

Table B.4

Regression results: CEO integrity, voluntary environmental disclosures, and assessed environmental performance (robustness green tweets)

Variables	(1) Rating Performance	(2) Rating Performance	(3) Rating Performance	(4) Rating Performance	(5) Rating Performance	(6) Rating Performance
GreenTweets	-0.0071***	-0.0071**	-0.0126***	-0.0126**	-0.0015***	-0.0015*
	(0.0015)	(0.0031)	(0.0031)	(0.0060)	(0.0003)	(0.0008)
TruthfulCEO	-0.0050	-0.0050	0.0069	0.0069	-0.0228***	-0.0228
	(0.0082)	(0.0221)	(0.0072)	(0.0210)	(0.0084)	(0.0253)
TruthfulCEO x GreenTweets	0.0055***	0.0055*	0.0078**	0.0078	0.0018***	0.0018**
	(0.0015)	(0.0032)	(0.0031)	(0.0064)	(0.0003)	(0.0009)
TwitterActivity	0.0005***	0.0005†	0.0004***	0.0004†		
	(0.0001)	(0.0003)	(0.0001)	(0.0003)		
LikesPerTweet	-0.0001***	-0.0001†	-0.0001***	-0.0001†	-0.0001***	-0.0001†
	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)
RepliesPerTweet	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001
	(0.0020)	(0.0026)	(0.0020)	(0.0025)	(0.0020)	(0.0026)
NewCEO	0.0284***	0.0284	0.0290***	0.0290	0.0284***	0.0284
	(0.0089)	(0.0276)	(0.0090)	(0.0277)	(0.0090)	(0.0280)
TenureCEO	0.0078***	0.0078*	0.0079***	0.0079*	0.0077***	0.0077*
	(0.0014)	(0.0042)	(0.0014)	(0.0042)	(0.0014)	(0.0042)
FirmSize	-0.0091†	-0.0091	-0.0100†	-0.0100	-0.0091†	-0.0091
	(0.0063)	(0.0172)	(0.0064)	(0.0174)	(0.0063)	(0.0172)
SalesGrowth	-0.1893***	-0.1893†	-0.1879***	-0.1879†	-0.1674***	-0.1674†
	(0.0427)	(0.1225)	(0.0431)	(0.1233)	(0.0404)	(0.1216)

Table B.4 (continued)

ROA	0.0034†	0.0034	0.0026	0.0026	0.0043*	0.0043
	(0.0023)	(0.0062)	(0.0023)	(0.0062)	(0.0023)	(0.0063)
CarbonEmissions	0.0001**	0.0001	0.0001**	0.0001	0.0001***	0.0001
	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)
LeverageRatio	0.1336***	0.1336	0.1248***	0.1248	0.1327***	0.1327
	(0.0443)	(0.1294)	(0.0447)	(0.1308)	(0.0466)	(0.1375)
MTB	-0.0068*	-0.0068	-0.0063†	-0.0063	-0.0076*	-0.0076
	(0.0041)	(0.0113)	(0.0041)	(0.0114)	(0.0042)	(0.0118)
RatingPerformancePY	-0.1077***	-0.1077*	-0.1048***	-0.1048*	-0.1110***	-0.1110*
	(0.0257)	(0.0564)	(0.0248)	(0.0559)	(0.0260)	(0.0572)
Pollution	-0.0107***	-0.0107**	-0.0108***	-0.0108**	-0.0098***	-0.0098**
	(0.0015)	(0.0048)	(0.0016)	(0.0049)	(0.0015)	(0.0047)
ISVI	0.0047	0.0047	0.0060	0.0060	0.0057	0.0057
	(0.0122)	(0.0144)	(0.0123)	(0.0144)	(0.0121)	(0.0142)
Observations	1,107	1,107	1,107	1,107	1,107	1,107
Adjusted R2	0.446	0.446	0.446	0.446	0.444	0.444
Year & Industry FE	✓	✓	✓	✓	✓	✓
Firm-Year Cluster	✗	✓	✗	✓	✗	✓

Note: The table reports regression coefficients of an OLS regression investigating whether the relation between voluntary environmental disclosures and assessed environmental performance is moderated by CEO integrity (see Model (3)). *RatingPerformance* is the relative change in firms' environmental rating. *GreenTweets* is the monthly number of environmental tweets. Columns (1) and (2) use a cutoff of two environmental terms to identify green tweets. Columns (3) and (4) use a cutoff of three environmental terms. Columns (5) and (6) use total tweets as a proxy for green tweets. *TruthfulCEO* is a dummy variable indicating whether a CEO is truthful or deceptive. *TwitterActivity* is the total number of tweets less the number of environmental tweets. *LikesPerTweet* and *RepliesPerTweet* are the ratios of likes or replies and the total number of tweets. *NewCEO* is a dummy variable indicating whether the CEO is new in his position. *TenureCEO* is the number of years since the current CEO's starting date. *FirmSize* is the natural logarithm of the firm's total assets. *SalesGrowth* is the firm's relative change in sales. *ROA* is the firm's return on assets. *CarbonEmissions* is the firm's level of carbon emissions in millions. *LeverageRatio* is the ratio of the firm's total liabilities and total assets. *MTB* is the firm's market-to-book ratio. *Pollution* is the relative annual

change in corporate carbon emissions. *ISVI* is the Investor Search Volume Index from Google Trends. Robust standard errors are reported in parentheses (***p<0.01, **p<0.05, *p<0.1 denote significance based on two-tailed tests; †p<0.1 denotes significance based on one-tailed tests). Appendix A provides all variable definitions.

Table B.5

Regression results: CEO integrity, environmental performance, and voluntary environmental disclosures (green tweets with non-negative tone)

Variables	(1) GreenTweets	(2) GreenTweets	(3) GreenTweets	(4) GreenTweets
Pollution	0.3196**	0.3196*	-0.0266	-0.0266
	(0.1534)	(0.1902)	(0.1777)	(0.1907)
TruthfulCEO	1.1103*	1.1103	1.5258**	1.5258
	(0.6350)	(1.2737)	(0.7020)	(1.1358)
TruthfulCEO x Pollution	-1.1785***	-1.1785	-2.4885***	-2.4885**
	(0.3678)	(0.7107)	(0.5762)	(1.0784)
TwitterActivity	0.3920***	0.3920***	0.3456***	0.3456***
	(0.0276)	(0.0636)	(0.0393)	(0.0584)
LikesPerTweet	-0.0025	-0.0025	-0.0071*	-0.0071
	(0.0037)	(0.0051)	(0.0038)	(0.0049)
RepliesPerTweet	-0.3200	-0.3200	-0.1221	-0.1221
	(0.2173)	(0.3730)	(0.2088)	(0.2364)
NewCEO	0.2805	0.2805	2.7746***	2.7746**
	(0.6180)	(1.2586)	(0.8385)	(1.3085)
TenureCEO	0.1497*	0.1497	0.0600	0.0600
	(0.0841)	(0.2309)	(0.1641)	(0.3092)
FirmSize	0.6855**	0.6855	13.7020***	13.7020**
	(0.3259)	(0.6426)	(2.9650)	(6.4433)
SalesGrowth	-12.1056***	-12.1056**	-0.3009	-0.3009
	(2.8234)	(5.5398)	(4.1673)	(5.6742)
ROA	-0.2052	-0.2052	-1.5151***	-1.5151***
	(0.1358)	(0.2724)	(0.3123)	(0.4747)
CarbonEmissions	-0.0164***	-0.0164*	0.1868**	0.1868*
	(0.0040)	(0.0084)	(0.0812)	(0.1111)
LeverageRatio	12.1103***	12.1103**	-1.2241	-1.2241
	(2.6007)	(5.6333)	(6.3596)	(12.2235)
MTB	-0.7417***	-0.7417*	-1.1122***	-1.1122**
	(0.2231)	(0.4293)	(0.2988)	(0.5425)
Observations	1,120	1,120	1,120	1,120
Adjusted R2	0.733	0.733	0.766	0.766
Year & Firm FE	✗	✗	✓	✓
Year & Industry FE	✓	✓	✗	✗

| Firm-Year Cluster | ✗ | ✓ | ✗ | ✓ |

Table B.5 (continued)

Note: The table reports regression coefficients of an OLS regression investigating whether the relation between environmental performance and voluntary environmental disclosures is moderated by CEO integrity (see Model (1)). *GreenTweets* is the monthly number of environmental tweets with a non-negative *Tone*. *Pollution* is the relative annual change in corporate carbon emissions. *TruthfulCEO* is a dummy variable indicating whether a CEO is truthful or deceptive. *TwitterActivity* is the total number of tweets less the number of environmental tweets. *LikesPerTweet* and *RepliesPerTweet* are the ratios of likes or replies and the total number of tweets. *NewCEO* is a dummy variable indicating whether the CEO is new in his position. *TenureCEO* is the number of years since the current CEO's starting date. *FirmSize* is the natural logarithm of the firm's total assets. *SalesGrowth* is the firm's relative change in sales. *ROA* is the firm's return on assets. *CarbonEmissions* is the firm's level of carbon emissions in millions. *LeverageRatio* is the ratio of the firm's total liabilities and total assets. *MTB* is the firm's market-to-book ratio. Column (1) reports the results with year and industry-fixed effects, and Column (2) adds clustered standard errors. For robustness, Column (3) includes year and firm fixed effects, and Column (4) adds clustered standard errors. Robust standard errors are reported in parentheses (***$p<0.01$, **$p<0.05$, *$p<0.1$). Appendix A provides all variable definitions.