



# When climate speaks, who answers? Climate change exposure, environmental disclosure and CEO characteristics in Europe

Mohammed Alzarah<sup>a,b</sup>, Apostolos Kourtis<sup>b,c,\*</sup>, Raphael N. Markellos<sup>b</sup>

<sup>a</sup> Finance Department, School of Business, King Faisal University, Al Hofuf, Saudi Arabia

<sup>b</sup> Norwich Business School, University of East Anglia, UK

<sup>c</sup> Institute for the Future, Department of Digital Innovation, School of Business, University of Nicosia, Cyprus

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## ABSTRACT

We study whether firm-specific climate change exposure affects environmental disclosure and how CEO traits influence this relationship. Using data from STOXX Europe 600 firms, we find that higher climate risk leads to higher-quality disclosure. A one-standard-deviation increase in climate change exposure is associated with up to a 28% increase in the disclosure score, relative to the sample average. This effect is stronger for firms with longer-tenured or younger CEOs. Our findings highlight that firm-level climate risk and CEO experience drive environmental transparency, even under Europe's rigid reporting standards.

## 1. Introduction

Climate risk has quickly moved from the footnotes of sustainability reports to the heart of European corporate strategy. The European Environment Agency reports that economic losses from extreme weather events surpassed €790B in the period 1980–2023 for EEA-38 member countries (European Environment Agency, 2025). Investors and other stakeholders require firms to provide transparent transition plans with evidence showing that markets reward them with higher valuations (Brooks and Oikonomou, 2018). At the same time, a new EU Corporate Sustainability Reporting Directive (CSRD) requires large firms to provide detailed information on several environmental factors, including their climate impact. However, empirical evidence shows that climate-related disclosure varies significantly across European firms despite facing similar regulations (e.g., Janicka and Sajnáč, 2023; Acheampong and Elshandidy, 2024). Why? This paper aims to answer this question by examining how climate-change exposure at the firm level impacts the quality of environmental disclosure and how CEO experience and compensation moderate this relationship. In this manner, it aims to advance the understanding of the roles of risk and leadership in environmental transparency.

Previous work has linked environmental disclosure to environmental performance, stakeholder pressure and analyst coverage (e.g., see Hummel and Schlick, 2016; Flammer et al., 2021; Cohen et al., 2023a;

Benlemlih et al., 2024; Khalifa et al., 2024; Xia et al., 2024). We contribute to this literature in three ways. First, we identify a new forward-looking measure of firm-specific climate change exposure by Sautner et al. (2023) as a driver of disclosure quality. This is based on transcripts of earnings conference calls and captures the views of both the management and participating analysts on the firm's climate change risk. Second, we move the focus inside the C-suite by studying how CEO experience and compensation affect environmental transparency, when climate risk is material for the firm. This is important as research on the role of these leadership traits in disclosure is limited (Mahran and Elamer, 2024). Third, we focus on Europe's strict climate-reporting environment which allows us to examine whether leadership still matters when external pressure to be transparent is already high. In this manner, we provide policy-relevant evidence ahead of the full implementation of CSRD.

We estimate fixed-effects panel models to study the impact of firm-specific climate change exposure and CEO characteristics on environmental disclosure quality. Our dataset includes firms from STOXX Europe 600 from 2010 to 2022, representing around 90 % of the region's free-float market capitalisation. Disclosure quality is proxied using the firm's Bloomberg's Environmental Disclosure Score. We consider three leadership traits, i.e., CEO age, CEO tenure and the presence of ESG-linked pay. The first captures general leadership experience, the second reflects experience within the firm and the third captures incentives

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\* Corresponding author at: Associate Professor in Finance, Norwich Business School, University of East Anglia, UK.

E-mail address: [a.kourtis@uea.ac.uk](mailto:a.kourtis@uea.ac.uk) (A. Kourtis).

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to promote sustainability. Together, they allow us to assess how executive experience and sustainability incentives affect environmental transparency.

Our results reveal that firms affected more by climate change tend to disclose higher-quality data about their environmental performance. Longer CEO tenure is associated with improved environmental reporting when firm-level climate risk is prominent. In contrast, CEO age reduces the firm's tendency to disclose when climate exposure is high. Finally, ESG-linked pay appears to have a positive but only marginally significant effect on disclosure, under high climate risk.

## 2. Data & methodology

We employ annual data for the constituent firms of STOXX 600 from 2010 to 2022. For each firm-year pair, we obtain climate change exposure scores based on the methodology of Sautner et al. (2023) from the OSF depository.<sup>1</sup> We match these with Environmental Disclosure Scores (EDS) provided by Bloomberg. EDS take values between 0 and 100 and uses up to 120 indicators drawing from annual reports, company websites, CSR reports and other sources. We obtain CEO tenure and age from Bloomberg and the "Policy Executive Compensation ESG Performance (PECE)" indicator from LSEG (Refinitiv). PECE takes a value of 1 if executive compensation depends on ESG targets. Finally, we collect information on several financial controls (size, leverage, return-on-equity, cash holdings and market-to-book ratio) from LSEG. All continuous variables are winsorised at the 1 % level in each tail. The final sample contains 474 firms and 3839 firm-years. The Appendix provides more information on each variable considered.

Table 1 presents summary statistics for our variables. Environmental disclosure averages 41 and exhibits significant variation, ranging from 0.2 to 79. The climate change exposure measure assumes a mean of 0.002. It also shows significant variation with a standard deviation of 0.003. CEO demographics show that the typical leader is 55 years old and has held the role for approximately 4.5 years. More than half of firm-years have an ESG-linked pay, reflecting its recent rise in Europe. The distribution of financial controls is as expected.

We study the relationship between climate change exposure, environmental disclosure quality and CEO characteristics using the following fixed-effects panel model:

$$EDS_{it} = \alpha + \beta cc\_expo_{it} + \sum_{m=1}^3 (\gamma_m Z_{m,it} + \delta_m cc\_expo_{it} \times Z_{m,it}) + \zeta' X_{it} + \mu_i + \lambda_t + \varepsilon_{it}. \quad (1)$$

**Table 1**  
Summary statistics.

Variable	Mean	Median	SD	Min	Max
EDS	41.020	40.592	18.424	0.223	79.040
cc_expo	0.002	0.001	0.003	0.000	0.016
CEO_tenure	5.746	4.500	4.972	0.167	27.000
CEO_age	54.731	55.000	5.882	40.000	68.000
PECE	0.544	1.000	0.498	0.000	1.000
ROE	15.127	12.990	16.274	-31.160	86.650
LEV	24.553	24.040	14.703	0.000	61.090
MTB	3.046	2.080	3.069	0.320	18.870
Cash	0.077	0.056	0.077	0.000	0.401
Size	16.841	16.679	1.768	13.173	21.594

**Note:** This table reports summary statistics for each variable in our analysis.

where  $EDS_{i,t}$  and  $cc\_expo_{i,t}$  are respectively the environmental disclosure score and the climate exposure measure for firm  $i$  in calendar year  $t$ .  $Z_{m,i,t}$  denote the CEO characteristics (age, tenure, or PECE), which enter the model both directly and through interactions with climate exposure.  $X_{i,t}$  is the vector of financial controls while  $\mu_i$  and  $\lambda_t$  denote country and year fixed effects, respectively.

## 3. Empirical results

We estimate two variants of (1), one without and one with CEO characteristics. We also compute t-statistics using Driscoll-Kraay (1998) standard errors with one lag, which are robust to heteroskedasticity, serial correlation, and cross-sectional dependence. Columns (1) and (2)

**Table 2**

Fixed-effects panel regressions of environmental disclosure on climate exposure and CEO characteristics.

	(1)	(2)	(3)	(4)
cc_expo	1578.883*** (11.33)	3840.396*** (4.33)		
cc_expo × CEO_tenure		52.125*** (3.27)		
CEO_tenure		-0.296*** (-4.98)		
cc_expo × CEO_age		-49.530** (-2.85)		
CEO_age		0.248*** (6.17)		
cc_expo × PECE		351.490* (1.93)		
PECE		-2.752*** (-4.24)		
cc_expo <sub>t-1</sub>			1577.345*** (10.61)	3944.280*** (3.59)
cc_expo <sub>t-1</sub> × CEO_tenure <sub>t-1</sub>				55.278*** (3.71)
CEO_tenure <sub>t-1</sub>				-0.304*** (-6.17)
cc_expo <sub>t-1</sub> × CEO_age <sub>t-1</sub>				-51.305** (-2.45)
CEO_age <sub>t-1</sub>				0.229*** (6.25)
cc_expo <sub>t-1</sub> × PECE <sub>t-1</sub>				341.110 (1.77)
PECE <sub>t-1</sub>				-2.875*** (-4.47)
ROE	0.066** (2.53)	0.064** (2.54)	0.043 (1.66)	0.044* (1.81)
LEV	0.106*** (6.82)	0.106*** (8.16)	0.100*** (7.77)	0.100*** (9.70)
MTB	-0.017 (-0.12)	0.063 (0.44)	0.065 (0.41)	0.135 (0.88)
Cash	-6.662* (-1.90)	-7.601** (-2.23)	-8.426** (-2.21)	-9.625** (-2.67)
Size	2.364*** (9.57)	2.227*** (8.96)	1.982*** (8.22)	1.858*** (7.87)
Constant	-13.412*** (-3.35)	-21.145*** (-5.51)	-3.765 (-0.91)	-7.330 (-1.68)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	3839	3839	3263	3263
Adj. R <sup>2</sup>	0.33	0.34	0.32	0.32

**Note:** This table presents estimates from two variants of model (1) in columns (1) and (2), respectively. Columns (3) and (4) assume lagged climate change exposure and CEO characteristics. The dependent variable is the environmental disclosure score. t-statistics based on Driscoll-Kraay (1998) standard errors with one lag are reported in parentheses. \*\*\*, \*\* and \* respectively denote statistical significance at the 1 %, 5 % and 10 % levels.

<sup>1</sup> We are grateful to Zacharias Sautner, Laurence van Lent, Grigory Vilkov and Ruishen Zhang that make firm-specific climate exposure scores available at <https://osf.io/fd6jq/>.

of Table 2 present our main results. The coefficient for *cc\_expo* is positive and highly significant, indicating that firms exposed to higher climate risk tend to release richer environmental data. This finding extends Basu et al. (2022), who show that managers allocate more space to climate issues in 10-K reports in high-risk industries, by providing firm-level evidence that actual disclosure quality increases with climate risk.<sup>2</sup>

The coefficients for climate change exposure appear large as the variable is measured in small units (median = 0.001). However, they correspond to economically meaningful improvements in disclosure quality. For example, the coefficient of 1579 in column (1) implies that a one-standard-deviation increase in climate exposure leads to an increase of 4.7 points ( $1579 \times 0.003$ ) in EDS. This translates to roughly 11 % of its mean value (41). Similarly, the coefficient of 3840 in column (2) corresponds to an increase of 11.5 points, or about 28 % of the mean EDS.

From column (2), we observe that the effect of CEO tenure on disclosure is negative (−0.296), i.e., under very low climate exposure, each additional year in the role slightly reduces disclosure score (EDS) by about 0.3 points. This finding is consistent with evidence from Lewis et al. (2014) that tenure is negatively associated with environmental disclosure. However, the significantly positive coefficient for the interaction between climate exposure and tenure shows that once climate risk rises, CEOs with extensive firm-specific experience are more likely to respond by improving disclosure quality. A one-standard-deviation increase in climate change exposure adds 11.52 points to the disclosure score when the CEO is new and 13.08 points (14 % more) when the CEO has a decade of tenure. This result identifies firm-specific CEO experience as a strategic asset for firms exposed to climate risk.

Column (2) reveals that older CEOs provide slightly more disclosure when climate change exposure is negligible. However, the coefficient of the interaction between exposure and CEO age is significantly negative (−49.53). For a 45-year-old CEO, a one-standard-deviation increase in *cc\_expo* adds 4.83 points to EDS, while for a 65-year-old CEO, it adds 1.86 points (61 % less). Hossain et al. (2023) and Le et al. (2024) document that generalist or older CEOs release more carbon emissions. We add to this evidence by showing that firms with heightened climate risk are more environmentally transparent when the CEO is younger. Similarly to Le et al. (2024), we attribute this finding to more prominent

climate awareness and stronger reputational incentives among younger CEOs.

The presence of Policy Executive Compensation ESG (PECE) is associated with lower EDS. However, the interaction of PECE with climate exposure is positive but only weakly significant. This finding suggests that ESG-linked pay may promote transparency under heightened climate risk, but the evidence is less robust than for CEO age and tenure. This likely reflects that ESG-linked pay primarily targets performance outcomes, such as emissions and diversity (Cohen et al., 2023b). As a result, its direct effect on disclosure may be limited. Additionally, the shorter history of ESG-linked pay in Europe (mostly post-2018 in our sample) may limit statistical power.

For robustness, columns (3) and (4) present results from estimating the two variants of model (1) using lagged climate exposure and CEO characteristics. These can address concerns of potential reverse causality, where firms that are already transparent talk more about climate issues in their earnings calls, inflating exposure scores. Also, they can address simultaneity concerns, since CEO characteristics and compensation could be adjusted in response to stakeholder demand for more disclosure. The results remain mostly consistent with our baseline findings, but the PECE interaction becomes insignificant.

Our findings have important implications for firms and regulators. First, our finding that higher climate exposure leads to greater environmental transparency shows that disclosure is a strategic response to increased risk. Second, leadership matters, even under strict disclosure regulations. On the one hand, our finding that CEO tenure improves environmental reporting under high climate risk indicates that accumulated knowledge of the firm becomes valuable when climate exposure increases. On the other hand, older CEOs appear to be less responsive when firm-specific climate risk rises, which can be attributed to lower reputational incentives and climate awareness. As a result, boards should consider retaining experienced CEOs when climate risk is high while also creating opportunities for younger executives who may be more responsive to climate change challenges. Regulators should also provide governance guidelines that align executive pay with transparent climate reporting. Future research could test our conclusions in non-European settings to explore whether our findings are applicable to different regulatory environments.

## Appendix: Variable definitions

Variable	Description	Source
<i>Environmental Disclosure Score (EDS)</i>	Environmental Variables	
	Standardized measure of environmental disclosure, based on up to 120 indicators, drawing from annual reports, company websites, CSR reports and other sources.	Bloomberg
<i>Climate Change Exposure (cc_expo)</i>	Relative frequency of climate-change bigrams in each earnings-call transcript.	OSF depository
<b>CEO Characteristics</b>		
<i>CEO_tenure</i>	Chief Executive Officer (CEO), or equivalent, tenure as of fiscal year (FY) end.	Bloomberg
<i>CEO_age</i>	Age of the CEO, or equivalent, in years.	Bloomberg
<i>Policy Executive Compensation ESG (PECE)</i>	Dummy = 1 if the remuneration policy formally ties remuneration for the CEO/other executives to ESG or sustainability metrics.	LSEG
<b>Financial Controls</b>		
<i>Size</i>	Natural log of total assets.	LSEG
<i>Leverage</i>	Total debt/total assets ( $\times 100$ ).	LSEG
<i>ROE</i>	(Net income – preferred dividends) $\div$ average common equity ( $\times 100$ ).	LSEG
<i>Cash</i>	Cash & equivalents/total assets.	LSEG
<i>Market-to-book</i>	Market value of equity/book value of equity.	LSEG

<sup>2</sup> To account for disclosure persistence, we also estimate a dynamic specification with lagged EDS. The results confirm strong persistence in disclosure, while the effect of climate change exposure remains positive and significant. Detailed results are available from the authors upon request.

## Data availability

Climate change exposure scores are openly available from the OSF repository. The remaining data are available from Bloomberg and LSEG.

## References

- Acheampong, A., Elshandidy, T., 2024. Do social and environmental disclosures impact information asymmetry? *Econ. Lett.* 234, 111487.
- Basu, S., Bhattacharya, S., Bhattacharya, M., Pathak, J., 2022. Climate-related discussions in firms' 10-K: who does it and what is its impact? *Econ. Lett.* 220, 110855.
- Benlemlih, M., Bitar, M., Ouadghiri, I.E., Peillex, J., 2024. Financial analyst coverage and corporate environmental disclosure. *Br. J. Manag.* 35 (3), 1609–1631.
- Brooks, C., Oikonomou, I., 2018. The effects of environmental, social and governance disclosures and performance on firm value: a review of the literature in accounting and finance. *Br. Account. Rev.* 50 (1), 1–15.
- Cohen, S., Kadach, I., Ormazabal, G., 2023a. Institutional investors, climate disclosure, and carbon emissions. *J. Account. Econ.* 76 (2–3), 101640.
- Cohen, S., Kadach, I., Ormazabal, G., Reichelstein, S., 2023b. Executive compensation tied to ESG performance: international evidence. *J. Account. Res.* 61 (3), 805–853.
- Driscoll, J.C., Kraay, A.C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. *Rev. Econ. Stat.* 80 (4), 549–560.
- European Environment Agency (EEA), 2025. *Economic Losses and Fatalities from Weather- and Climate-Related Extremes*. EEA Briefing. Available at: <https://www.eea.europa.eu/en/analysis/publications/economic-losses-from-climate-extremes>.
- Flammer, C., Toffel, M.W., Viswanathan, K., 2021. Shareholder activism and firms' voluntary disclosure of climate change risks. *Strateg. Manag. J.* 42 (10), 1850–1879.
- Hossain, A., Masum, A.A., Saadi, S., Benkraiem, R., 2023. Generalist CEO and carbon emissions. *J. Econ. Behav. Organ.* 213, 68–86.
- Hummel, K., Schlick, C., 2016. The relationship between sustainability performance and sustainability disclosure – Reconciling voluntary disclosure theory and legitimacy theory. *J. Account. Public Policy* 35 (5), 455–476.
- Janicka, M., Sajnog, A., 2023. The quality of environmental data disclosure. The case of public companies from the European union countries. *Eur. J. Sustain. Dev.* 12 (4), 149. -149.
- Khalifa, M., Ullah, S., Abdelfattah, T., 2024. Mapping the influence: institutional blockholder coordination and climate change risk disclosure. *J. Environ. Manag.* 370, 122788.
- Lewis, B.W., Walls, J.L., Dowell, G.W., 2014. Difference in degrees: CEO characteristics and firm environmental disclosure. *Strateg. Manag. J.* 35 (5), 712–722.
- Le, H., Nguyen, T., Gregoriou, A., 2024. CEO age and corporate environmental policies. *J. Int. Financ. Mark. Inst. Money* 97, 102076.
- Mahran, K., Elamer, A.A., 2024. Chief Executive Officer (CEO) and corporate environmental sustainability: a systematic literature review and avenues for future research. *Bus. Strategy Environ.* 33 (3), 1977–2003.
- Sautner, Z., Van Lent, L., Vilkov, G., Zhang, R., 2023. Firm-level climate change exposure. *J. Finance* 78 (3), 1449–1498.
- Xia, D., Shi, J., 2024. Individual investors' online voice and corporate environmental information disclosure. *Finance Res. Lett.* 62, 105262.