Essays on Sustainable Finance

University of Hamburg
at the School of Business, Economics, and Social Sciences

Dissertation
A thesis submitted in fulfillment of the requirements
for the degree of *Doctor Rerum Politicarum*

(in accordance with PromO as of January 18, 2017)

by
Simone Andrea Wagner
from Böblingen

Hamburg, November 30, 2023

Reviewers

First reviewer: Prof. Dr. Timo Busch
Second reviewer: Prof. Dr. Alexander Bassen

Examination committee:
Prof. Dr. Sebastian Späth (Chairman)
Prof. Dr. Timo Busch
Prof. Dr. Alexander Bassen

Place and date of oral defense (Disputation):
Hamburg, June 7, 2024

Acknowledgements

I am deeply grateful for the unwavering support, love, and guidance of numerous individuals who have assisted me in various ways throughout my dissertation journey. The process of finalizing papers during a pandemic and the war in Ukraine was incredibly challenging, and I am thankful for being in a comparatively safe environment. Over the past five years, I have written this dissertation while working full-time at the University of Hamburg and later at Advanced Impact Research (AIR) GmbH.

I would like to express my sincere appreciation to my first supervisor, Prof. Dr. Timo Busch, who not only gave me the opportunity to write this thesis but also provided a stable work environment as a research assistant at the University of Hamburg. In the same vein, I would like to thank my second supervisor, Prof. Dr. Alexander Bassen, and the committee members for their time, and expertise. Further, I am also grateful to the entire Management & Sustainability chair, especially Rita Streitt and Norina Haubold, who supported and helped me with management tasks during my studies. In particular, words cannot express my gratitude to Wiebke Szymczak – you have been my long-term companion for many years before I started my PhD studies and will always be a friend. I would also like to thank all the research assistants and student assistants at the chair who worked with me on my dissertation.

I further like to express my deepest gratitude to Roland Kölsch, who played a significant role in securing my funding at the University with the FNG-Label. His extensive practical knowledge and experience have been a source of encouragement throughout my daily life. I am profoundly grateful to Achim Gilbert for securing my funding and affording me the chance to embark on my journey as the Head of Certifications for Sustainable Investments at AIR. Moreover, I am also grateful to my colleagues at AIR, especially Eric Prüßner, for being a great colleague for many years.

Before COVID-19, I had the opportunity to participate in international research conferences, research seminars, and a summer school in St. Gallen. I am grateful to various researchers and other PhD students who have been valuable discussion partners and provided me with valuable insights into their research and econometric theory.

Finally, I would like to express my gratitude to my parents, especially my mother, Eva Wagner, for her unconditional love, passion, and always being available to answer the phone. I would also like to thank my close friend, Josephine Möslein, for being my best friend, soulmate, and confidante. Completing my study would have been impossible without the support system mentioned above. I consider myself incredibly fortunate to have had such a support system, and I believe that this dissertation is as much theirs as it is mine.

Abstract

This dissertation explores the role of sustainable finance in times of escalating environmental challenges, social inequities, and economic uncertainties. Sustainable finance is an interdisciplinary approach that integrates environmental, social, and governance (ESG) factors into financial decision-making. The European Commission (2023b) defines sustainable finance as the integration of sustainability principles into financial practices.

The integration of ESG factors into investments is pivotal for sustainable finance, with the financial industry witnessing the proliferation of ESG investment products. As a result, regulatory bodies and policymakers worldwide have begun mandating ESG disclosures to promote transparency for informed investment decisions. However, challenges persist, such as greenwashing, where environmental claims cannot be substantiated, due to the rapid growth of sustainable finance.

The dissertation comprises three research papers that illuminate various mechanisms within sustainable finance, enhancing the understanding of its rapid growth and associated challenges.

The first paper highlights the importance of Chief Executive Officers' (CEOs) early-life experiences in shaping their decisions regarding corporate climate strategies. This insight can help investors and other stakeholders assess the authenticity of a company's sustainability claims. CEOs with genuine concern for environmental issues, as a result of their early-life experiences, are more likely to implement effective climate policies, reducing the risk of greenwashing.

The second paper uncovers disparities in ESG scores and the underlying raw data among rating agencies (RAs). This transparency can help investors more effectively assess ESG ratings. It helps investors distinguish genuine sustainable practices from superficial ones, thus reducing the risk of greenwashing.

The third paper's negative relationship between CEO birthplace proximity and facility-level releases suggests that CEOs prioritize mitigating pollution in their hometown areas. Moreover, the paper offers a contrasting result, i.e., a positive relationship, for facilities that are closely located near their corporate headquarter (HQ). It encourages a closer examination of corporate practices and their environmental impacts, making it harder for firms to hide pollution behind geographical distances. This can deter greenwashing by promoting transparency in corporate pollution reporting.

In conclusion, the results drawn from these papers contribute to the current body of literature. Additionally, they deepen the understanding of various approaches to assessing sustainability through ESG scores. Further, they shed light on how these sustainability performance metrics can be shaped by the ecological environment's influence on CEOs and their life experiences.

Zusammenfassung

Die vorliegende Dissertation untersucht die Rolle nachhaltiger Finanzen in Zeiten anwachsender ökologischer Herausforderungen, sozialer Ungerechtigkeiten und wirtschaftlicher Ungewissheiten. Der interdisziplinäre Ansatz nachhaltiger Finanzen bezieht Faktoren aus Umwelt, Sozialem und guter Unternehmensführung (ESG) in die finanzielle Entscheidungsfindung ein. Die European Commission (2023b) definiert nachhaltige Finanzen als die Integration von Nachhaltigkeitsprinzipien in Finanzpraktiken.

Die Integration von ESG-Faktoren in Investitionen ist für die nachhaltige Finanzwirtschaft von zentraler Bedeutung, wobei die Finanzbranche eine zunehmende Verbreitung von ESG-Investmentprodukten erlebt. Infolgedessen haben Aufsichtsbehörden und politische Entscheidungsträger weltweit begonnen, die Offenlegung von ESG-Faktoren rechtlich zu verankern, um Transparenz für eine fundierte Anlageentscheidungen zu fördern. Aufgrund des rasanten Wachstums der nachhaltigen Finanzwirtschaft gibt es jedoch weiterhin Probleme wie Greenwashing, bei dem umweltbezogene Behauptungen nicht belegt werden können.

Die Dissertation umfasst drei Forschungsarbeiten, die verschiedene Mechanismen innerhalb des nachhaltigen Finanzwesens beleuchten und das Verständnis für das schnelle Wachstum und die damit verbundenen Herausforderungen verbessern.

Der erste Artikel unterstreicht die Bedeutung der Kindheitserfahrungen von CEOs in Bezug auf ihre Entscheidungen zu unternehmensweiten Klimastrategien. Diese Erkenntnis kann Investoren und anderen Interessensvertretern dabei helfen, die Authentizität der Nachhaltigkeitsversprechen eines Unternehmens zu beurteilen. CEOs mit hohem Umweltbewusstsein, das durch Kindheitserfahrungen geprägt wurde, sind mehr dazu geneigt wirksame klimapolitische Maßnahmen umzusetzen und verringern damit das Greenwashing-Risiko.

Die zweite Forschungsarbeit deckt Unterschiede in den ESG-Bewertungen und den zugrunde liegenden Rohdaten zwischen Ratingagenturen auf. Diese Transparenz kann Anlegern dabei helfen, ESG-Bewertungen effektiver zu prüfen. Sie hilft dabei, echte nachhaltige von oberflächlichen Praktiken zu unterscheiden und so die Gefahr von Greenwashing zu mindern.

Die im dritten Papier festgestellten negativen Zusammenhänge zwischen der Nähe zum Geburtsort des CEOs und den Emissionen an den Produktionsstätten, deuten auf eine vorranige Verringerung der Umweltverschmutzung in den Heimatstädten der CEOs hin. Darüber hinaus zeigt die Studie ein gegensätzliches Ergebnis, d.h. einen positiven Zusammenhang, für Produktionsstätten, die sich in unmittelbarer Nähe zu ihrem Unternehmenshauptsitz befinden. Dadurch wird zu zu einer genaueren Untersuchung von Unternehmenspraktiken und deren Umweltauswirkungen ermutigt, wodurch Unternehmen schwieriger Umweltverschmutzung hinter geo-

grafischen Entfernungen verbergen können. Dies kann Greenwashing verhindern, indem die Transparenz bei der Unternehmensberichterstattung bezüglich Umweltverschmutzung fördert.

Zusammen tragen die aus diesen Forschungsarbeiten abgeleiteten Ergebnisse einen Beitrag zur bestehenden Literatur bei. Darüber hinaus vertiefen sie das Verständnis zu verschiedenen Ansätzen zur Nachhaltigkeitsbewertung durch ESG-Scores. Des Weiteren beleuchten sie, wie diese Metriken der Nachhaltigkeitsleistung durch den Einfluss des ökologischen Umfelds auf CEOs und ihre Lebenserfahrungen geprägt werden können.

Contents

1 Introduction

"Sustainable finance refers to the process of taking environmental, social and governance (ESG) considerations into account when making investment decisions in the financial sector, leading to more long-term investments in sustainable economic activities and projects." (European Commission, 2023b).

In a time marked by escalating environmental challenges, social inequities, and economic uncertainties, sustainability has a critical role in our economy. Finance plays a pivotal role as an intermediary in driving economic growth and stability by facilitating the provision of credits, liquidity, and the management of risks, including services as an intermediary (Beck, 2011; Beck, Levine et al., 1999). Accordingly, research on *sustainable finance* as an interdisciplinary approach to tackling the intertwined threads of global economies and ecosystems has become increasingly important. As the quote from the European Commission (2023b) suggests, sustainable finance is the incorporation of sustainability principles into financial practices. In this vein, this dissertation embarks on a comprehensive exploration of the profound importance of sustainable finance as a requisite for ensuring a resilient and prosperous global economy and future.

In recent decades, the interplay between finance and sustainability has emerged as a focal point of scholarly inquiry, echoing growing recognition that the two domains are inextricably linked and wield significant influence over global economic trajectories. The history of sustainable finance is a testament to the dynamic interplay between economic prosperity, environmental stewardship, and societal well-being. Sustainable finance aims to improve the contribution of finance to sustainable growth (ibid.). Moreover, sustainable finance aspires to enhance financial stability and transparency by managing long-term (material) risks and intangible drivers of value creation. These includes factors related to ESG criteria (European Commission, 2023a; European Securities and Markets Authority, 2023).

The integration of ESG factors into investment decisions has become a cornerstone of sustainable finance. In recent years, the financial industry witnessed the proliferation of ESG-themed investment products (Grad View Research, 2023; A. Huang, 2021). Moreover, regulatory bodies and policymakers worldwide have begun to mandate ESG disclosures, recognizing its role in promoting transparency and informing investment decisions (European Commission, 2023a; European Securities and Markets Authority, 2023).

The surge in sustainable investments is driven by a confluence of factors, e.g., regulatory developments, and increasing awareness of ESG risks. Regulatory initiatives, such as the European Union's Sustainable Finance Action Plan, have propelled ESG integration by mandating disclosure and taxonomy standards (European Commission, 2018). Despite the opportunities of sustainable finance, there are inherent challenges that needs critical reflection, such as the potential for greenwashing. A study by the European Commission (2022) shows that "53.3 percent of examined environmental claims in the EU were found to be vague, misleading or unfounded and 40 percent were unsubstantiated. The absence of common rules for companies making voluntary green claims leads to 'greenwashing' and creates an uneven playing field in the EU's market, to the disadvantage of genuinely sustainable companies." This challenge underscores the need for rigorous due diligence as well as standardized sustainability metrics and reporting frameworks to ensure the effectiveness of sustainable finance.

The objective of this dissertation is to illuminate various mechanisms within the realm of sustainable finance, contributing to a more profound comprehension of the swift expansion in this sphere and the challenges it presents. This dissertation comprises three primary research articles. The first article, titled *"Climate (in)action? The relationship between CEO early-life experiences and corporate climate policies"*, adopts the viewpoint of CEOs and dives into their experiences from an early stage in life. Gaining insights into fundamental aspects of what (biographical circumstance) motivates CEOs to make environmentally conscious professional choices is fundamental to understanding, encouraging, and shaping these CEOs' decision-making in a manner that mitigates the risk of greenwashing.

Moreover, the assessment of what qualifies as "sustainable" is pivotal within this discussion. Consequently, the second paper, *"The Ratings Game: What Lies beneath ESG Scores? An Empirical Study of the Divergence and Underlying Data of ESG Scores"*, empirically juxtaposes ESG scores from the four most prominent RAs and explores their relationship with the underlying raw data that underpins these scores. For instance, does a modification to an underlying indicator correspond to a shift in the ESG scores? There are two important takeaways from this paper: first, being acquainted with the diverse definitions of ESG scores, and second, grasping the mechanisms linked to their underlying data, equips us with indispensable tools to fathom the trajectory of sustainable investment growth and its potential pitfalls.

The third research paper *"Don't foul your own nest! But who cares about the rest? CEOs' ecological embeddedness and corporate releases"* delves into CEOs' perspectives to gain insight into their managerial decisions. This article supplements the first paper in this dissertation about how CEOs' early-life disaster experiences influence their climate change (CC)-related choices in firms, by exploring CEOs' decision-making regarding corporate environmental policies, i.e., toxic releases. The paper examines these decisions in relation to CEOs' ecological embeddedness, considering factors such as their physical presence in the area and personal attachment to the land. It is crucial to understand these underlying factors, such as CEOs' personal backgrounds, as they drive environmentally responsible managerial decisions. This knowledge is essential for encouraging and influencing CEOs' decision-making in ways that prevent greenwashing.

As a result, the outcomes derived from these three articles will make a substantial contribution to the existing literature by enhancing our comprehension of diverse methodologies for measuring sustainability within ESG scores, as well as the ways in which these measurements of sustainability performance are influenced by the environment's impact on CEOs, their understanding of their environment, and their experiences. The next section outlines the research objectives and the central research question addressed within this dissertation. In Section 3, the research methodologies and the structural layout of this dissertation are delineated. Next, Section 4 summarises the main findings and contributions. Concluding this dissertation, Section 5 presents potential avenues for further research.

2 Research objectives

Nicholas Stern, a former chief economist at the World Bank, highlighted the fact that CC introduces a distinct challenge to economics: it stands as the most extensive and significant market failure ever observed (Stern, 2006). Unfortunately, governments and economic establishments have not effectively incorporated sustainability considerations into their decision-making processes. The pressing global issues of our era encompass CC, environmental deterioration, and societal disparities (Lee et al., 2023). Recently, there has been a growing emphasis on the imperative to transform the economic system in response to this urgency. Among others, one tool is *sustainable finance*. Despite the promising opportunities that sustainable finance offers, it confronts inherent challenges that warrant thoughtful examination. A case in point is the susceptibility to greenwashing (European Commission, 2022).

This dissertation responds to this challenge and engages with the subsequent general research question:

> *What constitutes sustainability metrics within sustainable finance, and what factors influence managerial decisions concerning them?*

Expanding on this inquiry, this project seeks to pursue interrelated research objectives. To begin with, the analysis centers on three distinct empirical research projects. Two of these projects are geared towards untangling the decision-making processes of CEOs in the context of environmental and climate policies. Both studies utilize an interdisciplinary approach, drawing from organizational and behavioral literature, to investigate the motivations that drive CEOs to advocate for sustainable choices regarding environmental and climate policies. In one paper, the spotlight is on the early-life natural hazard experiences of CEOs, particularly those related to CC-induced natural hazards. The other article delves into the concept of ecological embeddedness, recognizing it as a psychological factor that influences CEOs' pursuit of environmental-friendly corporate policies. Furthermore, within the framework of these research agendas, the third analysis examines ESG scores – a metric that has been commonly employed in literature over decades. By grasping the varying definitions of ESG scores and delving into the mechanisms associated with their underlying data, vital insights are gained that aid in comprehending the trajectory of growth in sustainable investments and the potential challenges inherent within this domain.

3 Structure and methods

This dissertation consists of three research papers that explore a range of methodologies used to assess sustainability within ESG scores. Moreover, it investigates how these evaluations of sustainability performance are affected by the environment's influence on CEOs and their understanding of their environment and experiences, as examined through empirical research using quantitative research methods.

In the following research endeavors, advanced econometric methods were selected to conduct the analyses. Consequently, all three research papers utilized regression analyses, a well-known technique for investigating causal relationships between dependent variable(s) and one or multiple independent variables (Wooldridge, 2015).

First research paper:
The first research paper employs Ordinary Least Squares (OLS) regression analyses and panel regression analyses to test its hypotheses. The analyses encompass both cross-sectional regressions where no observations over time are available and panel regressions where observations over time and individuals are available. Panel regressions acknowledge individual and time-specific influences, yielding insights into intricate dynamics and enabling control over unobservable variations and the assessment of causal associations (Wooldridge, 2010). In this vein, the use of fixed-effects estimations in the first research project addresses issues stemming from omitted variable bias and resultant endogeneity issues (Angrist and Pischke, 2009). Accounting for possible biases, such as a potential positive time trend in determinants of corporate climate policies, is crucial. Incorporating time-fixed effects permits the control of constant yet evolving unobservable factors across individuals and time. In this context, CEOs' inclinations towards climate-friendly policies could impact their affinity for specific firms. For example, CEOs with strong climate-friendly preferences might decline roles in firms with poor climate policies. By including a firm's climate policy record prior to a CEO's tenure as a constant firm control, potential self-selection effects can be managed and quantified. Commonly used firm controls help address time-varying firm characteristics. Natural hazards, affecting both CEOs and firms, can lead to endogeneity. Utilizing CEOs' (CC-related) hazard experiences during their early lives as independent variables, rather than recent occurrences, disentangles natural hazards' impacts on CEOs from corporate climate policy proxies. This strategy provides an exogenous measurement to explore the link between CEO's natural hazard experiences and corporate outcomes regarding climate policies. Additionally, it facilitates an examination of self-selection dynamics in CEO recruitment.

Second research paper:
The second research paper's primary analyses utilize OLS regression. Notably, these analyses

are conducted as part of a sensitivity analysis, a widely acknowledged practice in literature. This regression encompasses only a single independent variable of focus (Wooldridge, 2015). This method aims to directly quantify the extent to which an ESG score changes when the underlying raw data changes by a single unit.

Third research paper:
In the third research paper, econometric methodologies are likewise employed to explore the connection between distances of facilities from a company's HQs and the CEO's birthplace of CEOs and the company's toxic releases. To achieve this, a panel data set is created, comprising firm-year observations based on facility-level data concerning toxic releases in different media (i.e., air, water, land). In addition, an aggregation on the firm-level is conducted. The primary regression approach is centered on fixed-effects modeling, allowing the management of unobserved heterogeneity. This application of fixed-effects estimation helps alleviate concerns originating from omitted variable bias (ibid.). To control for unobserved changes in firm-level and industry-level factors over time, such as shifts in production volumes, alterations in ownership, or changes in corporate strategy, the study incorporates firm-year or industry-year fixed effects, respectively. These combined fixed effects not only capture the varying firm- or industry-specific factors, but they also encompass dynamic macro-level elements, like economic fluctuations or shocks, alongside stable firm- or industry-specific effects.

4 Results

4.1 Main findings

First research paper:

"Climate (in)action? The relationship between CEO early-life experiences and corporate climate policies", explores whether CEOs' early-life experiences of natural hazards influence their decision-making regarding corporate climate policies for their firm. In the face of increasing evidence regarding the adverse economic, social, and environmental impacts linked to human-induced CC, there has been a notable delay in proactive measures undertaken by businesses, households, and regulatory bodies. This observable phenomenon aligns with the established empirical concept termed the "attitude-behavior gap" (Ajzen and Fishbein, 1973), which has been thoroughly examined and summarized in a review by Sheeran and Webb (2016). Recent studies suggest that the psychological gap between oneself and the future implications of CC, termed psychological distance (Liberman et al., 2007), plays a key role in motivating action (e.g., McDonald et al., 2015). Experiences that bridge this psychological gap, as shown by previous research, can influence behavior (Fazio and Zanna, 1978, 1981). While it is acknowledged that the heightened risks posed by natural hazards serves as a prominent manifestation of anthropogenic CC's consequences (Bazaz et al., 2018), scant research has concentrated on the role of natural hazards explicitly (Sisco et al., 2017).

Despite the growing body of evidence linking CEO experiences with substantial variations in corporate policies across firms (e.g., Bernile et al., 2017; Chen et al., 2021; Kong et al., 2021; Malmendier et al., 2011; O'Sullivan et al., 2021), there is a dearth of focused research concerning the behavioral outcomes of natural hazard exposure on corporate climate policies. This scarcity could be attributed to the complex interplay between executives and companies in the context of recent natural hazards. Due to the broad impact of these hazards, it can be difficult to disentangle CEO behavior from its effects on firm operations or shifts in consumer preferences in their aftermath. A recent study has found a positive association between CEOs' early-life traumas and corporate social responsibility (CSR) (O'Sullivan et al., 2021), but CSR encompasses multifaceted dimensions, including environmental sustainability, social justice, ethics, and economic development. Focusing specifically on the climate-related facet of non-financial corporate performance permits a more targeted analysis of a critical issue that holds growing significance for both businesses and society.

Therefore, the paper addresses this research gap by investigating the repercussions of CEOs' early life experiences with natural hazards on climate policies. To address the joint-treatment challenge posed by recent hazard events influencing both CEOs and firms, the study employs data on natural hazards occurring in CEOs' birth counties five to fifteen years following their births, serving as proxies for individual hazard experiences in their early-life.[1] The study's sample encompasses decisions made by 447 CEOs born in the U.S. between 1991 and 2018. Specifically, the research paper analyses the effect of CEO early-life natural hazard experiences on climate policies in terms of (i) managerial discretion during their active tenure, and (ii) self-selection effects. Significantly, the paper employs two distinct proxies for climate policies, i.e., the KLD Climate Score and the ASSET4 Emissions Score. This approach serves to cross-reference and validate the outcomes, effectively tackling recent apprehensions regarding the credibility of CSR ratings and thus their reliability as climate-related indicators. In addition, the study specifies models with only CC-related natural hazards. Furthermore, recognizing that emissions are primarily concentrated in high-emission industries, climate policies are significantly pertinent and strategically crucial for companies within those sectors. Thus, the paper expands the model specifications with a dummy variable indicating high-emitting industries.

Results from the study demonstrate a noteworthy positive link between early-life hazard experiences and climate-related corporate policies during CEOs' tenures. Additionally, these findings remain consistent across various proxies and model specifications. Therefore, the study's outcomes highlight that natural hazards exert enduring influences on climate-related attitudes, thereby impacting the willingness to address CC issues.

However, when the study limits the analysis to CC-related hazard experiences, the previously observed positive correlation disappears. This diminishing effect seems to be particularly influenced by CEOs in high-emission sectors. Hence, concerning psychological factors, the results challenge the prevalent notion that early-life CC-related experiences lead individuals to make more environmentally conscious decisions. Instead, the results show a counterintuitive effect related to CC-related experiences.

In the second part of the analyses, the study tests for self-selection effects. While the study finds evidence supporting value-matching in CEO hiring for the KLD sample, there is no relevant relationship in the ASSET4 sample. Apart from methodological disparities, the behavioral implications of CC-related experiences in the context of selection are complex. Job-matching theory suggests a positive relationship, but the psychological distance argument proposes that relevant experiences enhance the willingness to take action. If early-life hazard experiences drive moral growth and inspire CEOs to advocate for change, it is plausible to expect that CEOs prioritize the need and potential for change over the compatibility of values in the current situation. CEOs motivated to make a positive impact may deliberately choose firms with poor climate policies or in high-emission industries, where their influence can be most significant.

[1] This study states the underlying assumption that most CEOs grew up near their birthplaces. Previous research by Bernile et al. (2017) confirms this, using CEOs' birth locations and state where they received their Social Security number. The data, similar to Bernile et al. (ibid.) and O'Sullivan et al. (2021), validates this assumption for this study.

Second research paper:
"The Ratings Game: What Lies beneath ESG Scores? An Empirical Study of the Divergence and Underlying Data of ESG Scores" explores ESG scores and their underlying raw data. With the growing significance of managing sustainability risks and opportunities in firm-level strategic management (e.g., Hart, 1995; Siegel and Vitaliano, 2007), these factors are now integral to investment decisions. A cluster of companies surfaced, providing sustainability metrics such as ESG scores. These scores are provided by Sustainability RAs, which assess a firm's corporate social performance, sustainability risk management, and disclosure practices (Directorate-General for Financial Stability, Financial Services and Capital Markets Union (European Commission), and Environmental Resources Management Ltd., 2020).

By focusing on ESG scores as a gauge of sustainability, this study investigates the disparities in scores and the underlying data that gives rise to them. Particularly, it delves into the scoring systems of the following well-recognized RAs: MSCI ESG Research Inc., Sustainalytics, Bloomberg, and Refinitiv Inc. The objective of the study is to unravel the effect of changes in the fundamental raw data on shifts in ESG scores. Prior research has underscored significant divergences in ESG score results owing to the differing attributes, weights, and measurement techniques adopted by different RAs.

The paper accentuates the importance of investigating these discrepancies, as the underlying data serves as the foundation for the reported information. The findings of this paper corroborate such existing research and adds to the question of whether ESG information can genuinely support sustainable development if it fails to accurately capture organizational reality (Busch et al., 2016). Similar concerns have been raised regarding the accuracy of RA measurements in reflecting firms' sustainability practices (e.g., Chatterji et al., 2016). Consequently, there is a push to identify effective gauges for ESG factors that truly effect sustainability.

To address this, the paper underscores the need to align ESG criteria with desired business activities, emphasizing the use of underlying raw sustainability measures to capture dynamic changes, and contributes to the literature on the mechanisms of ESG scores (e.g., Berg et al., 2022). This leads to an unexplored aspect: the relationship between changes in underlying raw data, like annual CO_2 emissions, and their reflection in ESG scores. This study thus centers on the reliability and comparability of ESG scores.

The core of the analyses revolves around the examination of the underlying raw data. Key indicators (KIs), such as carbon emissions in tons, are identified as the most frequently used raw data points across all four RAs. Extracted from Refinitiv's ASSET4 database, these indicators are scrutinized to understand the alignment between ESG scores, including their sub-pillars (E, S, and G), and the identified KIs. The results unveil disparities in the relationship between underlying data and ESG scores across different RAs. The study reveals varying reactions of ESG scores from different RAs to changes in underlying raw data in terms of magnitude and significance.

Third research paper:
"Don't foul your own nest! But who cares about the rest? CEOs' ecological embeddedness and corporate releases" formulates and tests the hypothesis that the geographical distance between corporate control and corporate production facilities predicts the extent of corporate releases attributable to the firm. Whiteman and Cooper (2000) introduce the concept of ecological embeddedness, which highlights the interdependence between human activities and ecosystems within a wider environmental framework. The literature emphasizes the intricate ties between organizations and their environment, emphasizing the mutual reliance between firms and the ecosystems in which they operate. This perspective posits that firms are not isolated entities but rather intimately connected to their surroundings (Hoffman, 1999; Hoffman and Jennings, 2015). Although the significance of place attachment, a key aspect of ecological embeddedness, has been extensively studied in environmental psychology (Lewicka, 2011), applying this concept to contemporary corporations presents challenges. Large corporations typically operate from multiple offices and production facilities dispersed across many counties or even countries, making this application less straightforward.

Understanding firms' ecological integration requires analyzing their decision-making processes. The Upper Echelons Theory (UET), introduced by Hambrick and Mason (1984) and expanded by Hambrick (2007), asserts that an organization's decisions are heavily influenced by the traits, skills, and values of its top executives, especially those in high management positions. In this context, empirical evidence supports the UET, indicating that managerial attributes significantly impact corporate policies (Bamber et al., 2010; Bertrand and Schoar, 2003; Bromiley and Rau, 2016; Graham et al., 2012). Notably, CEOs' characteristics and values affect various aspects of corporate behavior, including ESG policies (Chin et al., 2013; S. K. Huang, 2013; Lewis et al., 2014; Oh et al., 2016).

This study investigates the impact of the spatial relationship between corporate HQs and production facilities on corporate environmental policies, i.e., toxic releases. It uses latitude, longitude, and release data from the U.S. Environmental Protection Agency's Toxic Release Inventory (TRI), coupled with HQ information from S&P Compustat via Wharton Research Data Services (WRDS). The resulting data set spans over 25 years covering the period from 1994 to 2018.

Consistent with predictions from place attachment theory, an essential aspect of ecological embeddedness as defined by Whiteman and Cooper (2000), this study reveals that facilities and firms located near their CEOs birthplaces have lower industrial releases. The negative correlation between CEO birthplace proximity and facility-level releases suggests that CEOs prioritize mitigating pollution in their hometown areas. This finding underscores the role of personal connections and ecological embeddedness in shaping corporate environmental decisions, emphasizing the significance of CEOs' attachment to their places of origin.

Interestingly, a contrasting pattern emerges regarding the geographical proximity of facilities to corporate HQs: when corporate control centers are physically close to operational facilities, higher release levels are observed. This result challenges the concept of ecological embeddedness, questioning the positive impact of CEOs' physical presence and engagement with their operational environment on environmental outcomes in contemporary corporations. One potential explanation is the strategic positioning of important (often larger) facilities near corporate HQs for historical or operational reasons, coupled with CEOs' limited time spent in natural environments due to demanding schedules.

A remarkable reversal of these relationships occurs at the firm-level. Aggregate toxic releases are lower when corporate HQs are near CEOs' birthplaces but increase when facilities are close to CEOs' birthplaces. This highlights the complex interplay of reputation dynamics as a regulating factor in toxic releases. It suggests that facility-level reductions in releases may sometimes result from reputational concerns, yet this reduction could lead to an overall increase in releases as highly visible or closely monitored facilities improve their environmental performance while others do not. This complexity underscores the need for a comprehensive view of facilities within modern corporations.

Furthermore, the analysis of financial implications reveals that CEO locality can be both a source of agency costs and a driver of better management. CEOs born near facility locations often lead firms with higher aggregate pollution, lower profitability, and less favorable market evaluations, whereas CEOs born near their firms' HQs display the opposite trend.

In conclusion, the research sheds light on the intricate behavioral dynamics concerning the separation of control and production locations and corporate releases in contemporary corporations. The empirical findings provide nuanced insights into how CEO-level dynamics, geographical proximity, and reputation dynamics interact to influence environmental decisions, emphasizing the multifaceted nature of corporate environmental behavior.

4.2 Contributions

First research paper:

The research paper makes a valuable contribution to the UET, emphasizing the significant impact of top executives on corporate policies. It further validates the notion that CEOs' early-life experiences play a crucial role in shaping their professional decisions. When organizational decisions are influenced by individual executives, psychological factors like attitudes, preferences, and values become instrumental. This underscores the necessity of studying individuals as the primary unit of analysis, bridging the divide between the managerial and the psychological literature.

Additionally, the paper adds to the growing body of literature exploring the influence of CEOs' early-life natural hazard experiences on corporate climate policies. By focusing on experiences during their early lives, the paper manages to address the challenge of simultaneous treatment effects on both CEOs and their firms. Despite the significant time gap between these early-life experiences and their influence on managerial decisions, an increasing number of studies provide empirical evidence suggesting that such experiences have a lasting and substantial impact on CEOs' decision-making, which ultimately manifests in corporate policies during their leadership tenure (e.g., Bernile et al., 2017; Chen et al., 2021; Malmendier et al., 2011).

Focusing on the methodology, many studies on the determinants of corporate climate policies often grapple with endogeneity concerns, particularly when natural hazards simultaneously affect both the CEO and the entire firm. This study, however, mitigates these concerns by using CEOs' early-life experiences with natural hazards as the explanatory variable rather than recent experiences. This approach allows for seperating the timing of the natural hazard's impact on the CEO from the timing of corporate sustainability measurements, providing an exogenous proxy for CEO attitudes and enabling us to investigate the relationship between natural hazards and corporate climate policies. Additionally, this approach empowers the paper to not only control for but also explore the self-selection dynamics in CEO recruitment.

In this context, a closely related study is conducted by O'Sullivan et al. (2021), where the authors report a positive relationship between early-life exposure to natural hazards and CSR during CEOs' tenures. They conclude that when selecting CEOs, boards should take into consideration the early-life experiences of potential candidates. This paper, however, delves deeper into this relationship by specifically examining the marginal impact of CC-related hazards on corporate climate policies, as opposed to looking solely at aggregate CSR scores.

Contrary to common beliefs, the results challenge the idea that early-life CC-related experiences lead to environmentally conscious decisions. Recent studies indicate that reducing psychological distance through such experiences might not change attitudes significantly, especially for individuals with strong existing beliefs. Climate deniers could remain unconvinced despite worsening climate impacts. On the other hand, individuals already concerned might feel overwhelmed, leading to inaction and avoidance strategies. Addressing CC requires comprehensive systemic solutions; the loss of hope can foster apathy, hindering collective efforts. CEOs in high-emission industries, despite early-life climate experiences, might not implement climate-friendly policies due to intricate challenges and associated costs.

Further, these findings contribute to the expanding body of literature focusing on shifts toward climate-friendly practices following hazard experiences. Most studies in this area typically concentrate on short-term effects, such as extreme temperatures, often within the context of localized warming impacts.

Second research paper:
This research paper contributes to the expanding body of knowledge generated by both practitioners and scholars concerning the divergence of ESG scores and their transparency. It represents a pioneering effort to delve into the intricate relationship between the underlying raw data and ESG scores.

In this regard, the findings enrich the literature on the transparency and comprehension of ESG scores as tools for measuring sustainability. Previous research efforts (Berg et al., 2022) have already made significant strides in elucidating the key similarities and disparities between ESG scores. However, this study, leveraging a substantial data set from four prominent RAs, transcends these earlier endeavors by empirically dissecting the underlying factors influencing ESG scores. The paper unveils that the sensitivity of ESG scores and their individual pillar scores to changes in underlying raw data varies among RAs. This heterogeneity in sensitivity persists and cannot be solely attributed to regional or temporal differences.

The practical implications of this research extend to several dimensions. Firstly, these implications pertain to the selection of sustainability metrics employed in academic research and by industry practitioners. The outcomes of studies are heavily contingent on the choice of ESG score and the RA. Therefore, it is imperative for researchers to elucidate the rationale behind their selection, particularly when aiming to focus on specific firm characteristics. In cases where research questions permit, another strategy could involve utilizing the raw data directly reported by the firm.

Furthermore, the choice of an RA significantly influences investment decisions by various stakeholders, ranging from asset managers to governmental entities. Additionally, companies subject to RA ratings should ensure that these metrics align with their individual goals and contribute to genuine progress in sustainability, rather than pursuing higher ESG scores purely for the sake of ratings. Lastly, regulatory bodies could foster harmonization in ESG scores by establishing more consistent guidelines for ESG disclosures by firms. Through this study, all these stakeholders can gain deeper insights into the intricate relationship between ESG scores and the underlying raw data, thereby enhancing their understanding of the mechanisms at play.

Third research paper:
This study's findings offer valuable insights into how the spatial relationships between corporate control and production sites in modern corporations impact environmental outcomes at both facility- and firm-levels.

This research contributes to the interdisciplinary literature on the behavioral determinants of environmental decision-making, specifically within top management. By empirically validating the UET, the study highlights the substantial influence of CEO-level variables on corporate environmental policies, emphasizing the pivotal role of CEOs in shaping these strategies (Hambrick, 2007; Hambrick and Mason, 1984). Additionally, the study adds new insights into the understanding of place attachment as a moderator of environmental-friendly behavior. While previous studies have predominantly explored the individual aspect of this threefold framework, this research delves deeper into the intersection of psychology and place. Recognizing the distinct locations of corporate control (HQs) and production facilities in modern corporations, the findings offer fresh perspectives on the balance between place identity and place dependence.

A notable feature of this study is its acknowledgment of the inherent geographical division in modern corporations, evident in the separate locations for corporate HQs and production facilities. Notably, the results of this study provide fresh perspectives on the importance of place identity versus place dependence in shaping corporate environmental decisions. This differentiation highlights the intricate relationship between attachment to the place of control and the place of production within current corporate frameworks. Moreover, these insights critically assess the validity of the ecological embeddedness conceptualization proposed by Whiteman and Cooper (2000).

Beyond its theoretical contributions, the paper provides a detailed exploration of the TRI dataset, emphasizing its relevance in environmental research. Recognizing the TRI dataset's value in promoting transparency and accountability in environmental management, this study demonstrates its potential in informing more effective environmental policies and practices in the United States. These insights hold implications for both theoretical advancements and practical applications, guiding managers and policymakers to consider ecological embeddedness and spatial dynamics in their decision-making processes and environmental strategies.

5 Discussion and conclusion

This dissertation faces multiple challenges in selecting suitable proxies and operationalizing corporate constructs, leading to several limitations in the research methodology.

The first important limitation of this thesis is how corporate climate policies are operationalized. Given the challenges in obtaining reliable and comparable data on corporate climate strategies, the research relies on third-party scores as a practical alternative. Although this approach is widely used to operationalize various dimensions of corporate ESG policies, recent doubts have been raised about the validity of third-party ESG scores, including corporate climate scores (e.g., Berg et al., 2022; Chatterji et al., 2016; Dorfleitner et al., 2015). This limitation concerns the first and second papers in particular. To address these concerns to some extent, the first paper tests its hypotheses using two alternative proxies for corporate climate policies based on KLD social ratings and ASSET4 ESG scores, both commonly utilized in research (e.g., Albuquerque et al., 2019; Waddock and Graves, 1997). Notably, there are empirical concerns about the validity of aggregating measures without validating the factor aggregation (Mattingly and Berman, 2006), particularly regarding the KLD sample. Additionally, substantial disparities between ASSET4 and KLD scores have been acknowledged (Berg et al., 2022; Dorfleitner et al., 2015).

To ensure the reliability of the third-party proxies for corporate climate policies, the thesis employs alternative measures when appropriate. However, combining CSR data into a single net score could potentially average out positive and negative differences, raising empirical issues. The dissertation's robust findings across samples, despite methodological differences between the rating approaches, enhance the credibility of the results.

Second, this dissertation has a significant limitation as a result of its use of CEOs' birthplaces and birth years as proxies for their childhood and early adolescent locations, a concern in the first and third papers. Despite previous validation by researchers like Bernile et al. (2017), who initially proposed this identification strategy, O'Sullivan et al. (2021) noted the importance of the place where a person grows up. The papers follow the mapping strategy from Bernile et al. (2017), therefore inheriting its potential limitations. Although CEOs might have moved during their early years, recent research suggests strong attachments to birthplaces even in adulthood, indicating lasting social connections (e.g., Lai et al., 2020). Consequently, even if CEOs did not spend their entire childhood and adolescence in their birthplaces, it remains likely that they retained significant social connections with these regions. Therefore, CEOs may still have been exposed to the repercussions of severe natural hazards near their birthplaces, even if their parents no longer resided in the area.

Third, the third paper employs corporate HQs as a substitute for the usual residence of CEOs. It is possible that some CEOs operate primarily from local offices or work remotely, or they may travel between different locations. Although tracking CEOs' exact locations is challenging and often ethically problematic, their office locations provide a reasonable indication of their typical residence. Especially in pre-Covid times, which the third paper focuses on, it was generally assumed that a CEO's residence was in proximity to their workplace. Corporate HQs typically house the executive functions of a corporation, where the management and key staff oversee overall business activities. Consequently, a CEO's habitual residence is likely to be within a reasonable commuting distance from corporate HQs. In theory, it is feasible to contact companies to request precise information about the exact locations of corporate executive offices. However, practical constraints and concerns about operational risk within firms may restrict the availability of accurate disclosures regarding CEO locations.

Lastly, the selection of environmental proxies plays a significant role in the empirical framework of the third paper. As a result, the paper relies on the TRI data set despite its limitations. First, not all industries or facility types are mandated to report to the TRI, leading to potential gaps in the data. Certain facilities are exempt, and reporting thresholds might exclude smaller releases, possibly underrepresenting the true extent of toxic releases. Additionally, the accuracy of the data hinges on the honesty of reporting industries, introducing the possibility of discrepancies or errors, even though regulations and protocols are in place to minimize this issue. Second, TRI focuses on specific harmful chemicals, yet there are numerous chemicals in use, and not all of them are covered by the TRI. This limitation can create a distorted view of the overall landscape of chemical pollution. Third, while TRI provides data on chemical releases, it lacks detailed information about the reasons behind these releases or how these chemicals are being utilized. Understanding the context of these emissions is vital for the development of effective environmental policies. Lastly, TRI data is reported annually, potentially missing sudden or short-term spikes in toxic releases. This limitation can impact the assessment of trends and immediate responses to environmental incidents. Further exploration of the TRI data set is warranted. Specifically, delving into disparities among industry releases or considering alternative measures to assess human exposure to hazardous chemicals, such as sub-indicators derived from the TRI data set, could provide valuable insights.

Aside from the challenges related to proxy selection, the second paper is constrained by its statistical approach. Concerns arise about the regression's completeness due to potential missing independent variables for sensitivity analyses. However, it is crucial to clarify that the paper doesn't claim to pursue comprehensiveness. Instead, its goal is to offer a basic insight into how ESG scores respond to shifts in individual raw data variables. To address this limitation, the paper performed all analyses using data from four well-known RAs.

In terms of psychological dynamics, the dissertation's results (from the first paper) challenge the common assumption that early-life CC-related experiences lead individuals to adopt more environmentally friendly behaviors. In fact, the first paper reveals the counterintuitive effect of these experiences. While this argument seems plausible and intuitive, recent studies have suggested that reducing the psychological distance through relevant experiences is likely to influence attitudes primarily among decision-makers lacking strong prior convictions. Surprisingly, the first paper even indicates a slightly negative relationship between CC-related experiences and climate policies for CEOs in high-emission industries. To delve deeper into the behavioral impact of these experiences on climate action in organizational decision-making, further research is necessary. One possible explanation is that managers with such early-life experiences may adopt a self-legitimizing strategy, reasoning that CC has always existed, the system is unchangeable, and engaging in costly mitigation strategies is unwarranted.

In subsequent studies, it would be valuable to examine additional sub-scores within well-established sustainability ratings or investigate the impact of natural hazards on different metrics of corporate sustainability, such as SDG mapping. Additionally, it is crucial to explore whether the shift towards climate-friendly practices following natural hazards necessitates direct personal experiences or if relevant experiences can be simulated through virtual reality technology. Understanding these underlying processes and conditions could bridge the gap between attitudes and behaviors in corporate decision-making and the broader public. Furthermore, future research could explore whether corporate executives from regions disproportionately affected by natural disasters, such as the Global South, are more effective catalysts for change.

The dissertation underscores the importance of further research into the impact of CEOs' life experiences on their professional decisions. According to the UET, if organizational decisions are heavily influenced by top executives, psychological factors, such as attitudes and values, are likely to play a crucial role. This emphasizes the need to focus on individuals as the central unit of analysis, bridging the gap between managerial and psychological literature for a comprehensive understanding of organizational behavior.

Understanding the intricate psychological dynamics of influential decision-makers, particularly top executives, is essential for creating effective policies and incentives that promote corporate climate action. The complexity of these dynamics, which is influenced by specific contexts, highlights the need for further exploration. Surprisingly, the study finds that experiences related to CC do not always result in CEOs embracing environmentally friendly policies and may in fact lead to unintended consequences. Therefore, there is a need for additional research to investigate the factors that moderate the behavioral impact of CC-related experiences on climate action, especially within organizational settings. Furthermore, while the early-life experiences of CEO candidates could impact executive hiring decisions, it is crucial to acknowledge that the direction of this influence may vary based on existing beliefs and the surrounding context, including ongoing political or geopolitical developments, which are yet to be fully understood as determinants of climate policies.

As U.S. and European regulators prepare substantial initiatives in the realm of sustainable finance, the roles of transparency and disclosure standards are garnering increased attention. In this context, regulatory frameworks are being formulated to combat misleading information concerning the sustainability aspects of financial products. These actions are deemed necessary as a growing number of financial products claim to have a tangible impact on real-world indicators. These claims are often substantiated by the products of RAs, which have emerged alongside ESG scores to assess a firm's sustainability. Further research into these new metrics is imperative to understand their relationship with the raw data variables reported by companies.

In conclusion, this dissertation provides new perspectives and methods to combat greenwashing by distinguishing genuine environmental commitment from superficial claims. The first paper underscores the significance of CEOs' early-life (CC-related) hazard experiences in shaping corporate climate policies, providing valuable insights into CEOs' professional decision-making to identify authentic environmental practices. The second paper emphasizes transparency in sustainability metrics and RA scores, urging the market to genuinely align ESG scores with companies' actions, i.e., the underlying raw data. Lastly, the third paper advances the understanding of CEOs' environmental behavior, aiding stakeholders in identifying greenwashing by looking at actual environmental impacts, i.e., toxic releases. Together, the results and contributions of this thesis promote more accurate assessments of environmental efforts and discourage greenwashing practices.

However, it is crucial to recognize the limitations and identify opportunities for future research. In essence, upcoming studies should investigate whether corporate executives originating from regions disproportionately impacted by CC, such as those in the Global South, prove to be more effective agents for promoting sustainability. Exploring how regional backgrounds shape executive decision-making and corporate strategies could yield valuable knowledge for combating global greenwashing. Moreover, to better comprehend the relationship between ESG scores and the underlying raw data variables reported by companies, a thorough exploration of new sustainability metrics is necessary. This effort is vital to expose greenwashing and authenticate sustainability in corporate practices. Additionally, future research stands to gain from more precise measurements and a more profound investigation into the aspects of ecological embeddedness contributing to environmental decision-making. By combining these research efforts, a comprehensive understanding of how regulatory environments and incentives drive companies to adopt sustainable practices and counter greenwashing could emerge. Future studies should build upon these discoveries, striving to develop more inclusive and effective strategies for addressing CC and nurturing responsible corporate conduct.

References

Ajzen, I., & Fishbein, M. (1973). Attitudinal and normative variables as predictors of specific behavior. *Journal of personality and Social Psychology*, *27*(1), 41–57.

Albuquerque, R., Koskinen, Y., & Zhang, C. (2019). Corporate social responsibility and firm risk: Theory and empirical evidence. *Management Science*, *65*(10), 4451–4469.

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

Bamber, L. S., Jiang, J., & Wang, I. Y. (2010). What's my style? The influence of top managers on voluntary corporate financial disclosure. *The Accounting Review*, *85*(4), 1131–1162.

Bazaz, A., Bertoldi, P., Buckeridge, M., Cartwright, A., de Coninck, H., Engelbrecht, F., Jacob, D., Hourcade, J.-C., Klaus, I., de Kleijne, K., et al. (2018). *Summary for urban policymakers: What the IPCC Special Report on global warming of* $1.5°C$ *means for cities* (tech. rep.). IHHS Indian Institute for Human Settlements, Bengaluru. India.

Beck, T. (2011). The role of finance in economic development: Benefits, risks, and politics. *The Oxford Handbook of Capitalism*.

Beck, T., Levine, R., et al. (1999). *A new database on financial development and structure* (Vol. 2146). World Bank Publications.

Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of esg rating. *Review of Finance*.

Bernile, G., Bhagwat, V., & Rau, P. R. (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and ceo behavior. *The Journal of Finance*, *72*(1), 167–206.

Bertrand, M., & Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics*, *118*(4), 1169–1208.

Bromiley, P., & Rau, D. (2016). Social, behavioral, and cognitive influences on upper echelons during strategy process: A literature review. *Journal of Management*, *42*(1), 174–202.

Busch, T., Bauer, R., & Orlitzky, M. (2016). Sustainable development and financial markets: Old paths and new avenues. *Business & Society*, *55*(3), 303–329.

Chatterji, A. K., Durand, R., Levine, D. I., & Touboul, S. (2016). Do ratings of firms converge? implications for managers, investors and strategy researchers. *Strategic Management Journal*, *37*(8), 1597–1614.

Chen, Y., Fan, Q., Yang, X., & Zolotoy, L. (2021). Ceo early-life disaster experience and stock price crash risk. *Journal of Corporate Finance*, *68*, 101928.

Chin, M., Hambrick, D. C., & Treviño, L. K. (2013). Political ideologies of ceos: The influence of executives' values on corporate social responsibility. *Administrative Science Quarterly*, *58*(2), 197–232.

Directorate-General for Financial Stability, Financial Services and Capital Markets Union (European Commission), and Environmental Resources Management Ltd. (2020). *Study on sustainability-related ratings, data and research*. Retrieved January 20, 2021, from https://op.europa.eu/en/publication-detail/-/publication/d7d85036-509c-11eb-b59f-01aa75ed71a1

Dorfleitner, G., Halbritter, G., & Nguyen, M. (2015). Measuring the level and risk of corporate responsibility–an empirical comparison of different esg rating approaches. *Journal of Asset Management*, *16*, 450–466.

European Commission. (2018). *Communication from the commission to the european parliament, the european council, the council, the european central bank, the european economic and social committee and the committee of the regions – action plan: Financing sustainable growth*. Retrieved August 19, 2023, from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0097

European Commission. (2022). *Commission staff working document – impact assessment report*. Retrieved August 19, 2023, from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022SC0085

European Commission. (2023a). *Consumer protection: Enabling sustainable choices and ending greenwashing*. Retrieved August 19, 2023, from https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1692

European Commission. (2023b). *Finance – overview of sustainable finance*. Retrieved August 19, 2023, from https://finance.ec.europa.eu/sustainable-finance/overview-sustainable-finance_en#what

European Securities and Markets Authority. (2023). *Esma's activities – sustainable finance*. Retrieved August 19, 2023, from https://www.esma.europa.eu/esmas-activities/sustainable-finance

Fazio, R. H., & Zanna, M. P. (1978). Attitudinal qualities relating to the strength of the attitude-behavior relationship. *Journal of Experimental Social Psychology*, *14*(4), 398–408.

Fazio, R. H., & Zanna, M. P. (1981). Direct experience and attitude-behavior consistency. In *Advances in experimental social psychology* (pp. 161–202, Vol. 14). Elsevier.

Grad View Research. (2023). *Sustainable finance market size, share & trends analysis report by asset class, by offerings, by investment style, by investor type, by region, and segment forecasts, 2023 - 2030 – report overview*. Retrieved August 19, 2023, from https://www.grandviewresearch.com/industry-analysis/sustainable-finance-market-report#:~:text=Report%20Overview,USD%2037.80%20trillion%20in%202022

Graham, J. R., Li, S., & Qiu, J. (2012). Managerial attributes and executive compensation. *The Review of Financial Studies*, *25*(1), 144–186.

Hambrick, D. C. (2007). Upper Echelons Theory: An Update. *Academy of Management Review*, *32*(2), 334–343.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193–206.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management review*, *20*(4), 986–1014.

Hoffman, A. J. (1999). Institutional evolution and change: Environmentalism and the us chemical industry. *Academy of management journal*, *42*(4), 351–371.

Hoffman, A. J., & Jennings, P. D. (2015). Institutional theory and the natural environment: Research in (and on) the anthropocene. *Organization & Environment*, *28*(1), 8–31.

Huang, A. (2021). *The $35 trillion sustainable finance market gets greater clarity*. Retrieved August 19, 2023, from https://www.bloomberg.com/news/articles/2021-11-08/the-35-trillion-sustainable-finance-market-gets-greater-clarity#xj4y7vzkg

Huang, S. K. (2013). The impact of ceo characteristics on corporate sustainable development. *Corporate Social Responsibility and Environmental Management*, *20*(4), 234–244.

Kong, D., Zhao, Y., & Liu, S. (2021). Trust and innovation: Evidence from ceos' early-life experience. *Journal of Corporate Finance*, *69*, 101984.

Lai, S., Li, Z., & Yang, Y. G. (2020). East, west, home's best: Do local ceos behave less myopically? *The Accounting Review*, *95*(2), 227–255.

Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barrett, K., et al. (2023). Ar6 synthesis report: Climate change 2023. *Summary for Policymakers*.

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of environmental psychology*, *31*(3), 207–230.

Lewis, B. W., Walls, J. L., & Dowell, G. W. (2014). Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal*, *35*(5), 712–722.

Liberman, N., Trope, Y., Stephan, E., et al. (2007). Psychological distance. *Social psychology: Handbook of basic principles*, *2*, 353–383.

Malmendier, U., Tate, G., & Yan, J. (2011). Overconfidence and early-life experiences: The effect of managerial traits on corporate financial policies. *The Journal of finance*, *66*(5), 1687–1733.

Mattingly, J. E., & Berman, S. L. (2006). Measurement of corporate social action: Discovering taxonomy in the kinder lydenburg domini ratings data. *Business & Society*, *45*(1), 20–46.

McDonald, R. I., Chai, H. Y., & Newell, B. R. (2015). Personal experience and the 'psychological distance' of climate change: An integrative review. *Journal of Environmental Psychology*, *44*, 109–118.

Oh, W.-Y., Chang, Y. K., & Cheng, Z. (2016). When ceo career horizon problems matter for corporate social responsibility: The moderating roles of industry-level discretion and blockholder ownership. *Journal of Business Ethics*, *133*(2), 279–291.

O'Sullivan, D., Zolotoy, L., & Fan, Q. (2021). Ceo early-life disaster experience and corporate social performance. *Strategic Management Journal*, *42*(11), 2137–2161.

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and personality psychology compass*, *10*(9), 503–518.

Siegel, D. S., & Vitaliano, D. F. (2007). An empirical analysis of the strategic use of corporate social responsibility. *Journal of Economics & Management Strategy*, *16*(3), 773–792.

Sisco, M. R., Bosetti, V., & Weber, E. U. (2017). When do extreme weather events generate attention to climate change? *Climatic Change*, *143*(1-2), 227–241.

Stern, N. (2006). Stern review: The economics of climate change.

Waddock, S. A., & Graves, S. B. (1997). The corporate social performance–financial performance link. *Strategic management journal*, *18*(4), 303–319.

Whiteman, G., & Cooper, W. H. (2000). Ecological embeddedness. *Academy of management journal*, *43*(6), 1265–1282.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Nelson Education.

Each of the research papers is included in the appendix to this dissertation. The submission status of the publications, as of November 30, 2023, is:

1. Szymczak, W., Wagner S.A., and Busch, T. (2023). **Climate (in)action? The relationship between CEO early-life experiences and corporate climate policies**, *Organization & Environment*, submitted (after first review and submission).

2. Wagner, S.A. (2023). **The Ratings Game: What's beneath ESG Scores? An Empirical Study of the Divergence and Underlying Data of ESG Scores**, *Business Strategy and the Environment*, submitted.

3. Szymczak, W. and Wagner S.A. (2023): **Don't foul your own nest! But who cares about the rest? CEOs' ecological embeddedness and corporate releases**, *Administrative Science Quarterly*, submitted.

Appendix A. First research paper

Climate (in)action? The relationship between CEO early-life experiences and corporate climate policies

Climate (in)action? The relationship between CEO early-life experiences and corporate climate policies*

Wiebke Szymczak† Simone A. Wagner‡ Timo Busch§

Abstract

While the drastic physical impacts of climate change and related natural hazards are increasingly apparent, little is known about the long-term behavioral consequences of climate-related (CC-related) experiences. Psychological evidence suggests that CC-related experiences induce people to make more climate-friendly choices. Building on the Upper Echelons Theory and relevant psychological literature, we investigate whether early-life natural hazard experiences of a Chief Executive Officer (CEO) are associated with more climate-friendly policies during their tenure. Our sample covers decisions by 447 US-born CEOs between 1991 and 2018. While we observe an effect of hazard experiences on climate policies, we cannot observe the same effect when focusing only on CC-related experiences. Moreover, when considering high-emitting industries, we come to a surprising outcome: CEOs with CC-related experiences appear to adopt less climate-friendly policies during their tenures compared to CEOs without CC-related hazard experiences.

Keywords: climate change, early-life hazard experiences, chief executive officers, upper echelons, psychological distance

*We are grateful for financial support from the Institute of Hazard, Risk and Resilience at Durham University. Moreover, we would like to thank Georg Benjamin Fiedler for his valuable assistance in compiling and analyzing the data.

†University of Hamburg, Corresponding author: wiebke.szymczak@uni-hamburg.de

‡University of Hamburg

§University of Hamburg

1 Introduction

Climate change is a critical global issue with devastating economic, social, and environmental consequences. While firms are increasingly recognizing their responsibility to shift towards climate-friendly business models and corporate policies, there is a gap between intentions and actual change – an empirical pattern known as the attitude-behavior gap (Ajzen, 1991; Ajzen and Fishbein, 1973)(see Sheeran and Webb, 2016, for a review). This discrepancy may be exacerbated by the fact that climate change "is not inconvenient if you're not affected by it at all", as declared by Richard Nugee, the former head of climate change and sustainability strategy at the UK's Ministry of Defence (Reuters, 2020). On an organizational level, this sense of not being directly affected could lead to inaction towards climate change as described by Slawinski et al. (2017).

Indeed, psychological studies suggest that psychological distance (Liberman et al., 2007), i.e., the cognitive separation between the present-day self and the future impact of climate change, is an important moderator of the willingness to act (see McDonald et al., 2015, for a review). Relevant biographical experiences can reduce psychological distance and can motivate people to act (Fazio and Zanna, 1981, 1978). Moreover, there is relative consensus that people learn more from experience than from intellectual reflection (Kolb et al., 2001) and frequently use their own experiences as substitutes for objective evidence (Kahneman and Frederick, 2002; Tversky and Kahneman, 1974; Kahneman and Tversky, 1972).

In line with this reasoning, previous studies have demonstrated that local weather conditions can generate attention for climate change (Sisco et al., 2017; Zaval et al., 2014; Rudman et al., 2013; Egan and Mullin, 2012; Joireman et al., 2010) and may even trigger a behavioral shift towards more climate-friendly choices (see, for instance, Choi et al., 2020; Zanocco et al., 2018; Akerlof et al., 2013; Lowe et al., 2006). While it is generally accepted that the increased frequency and severity of natural hazards are salient manifestations of anthropogenic climate change (Bazaz et al., 2018), few papers have investigated the role of natural hazards in promoting climate action (Sisco et al., 2017). Moreover, despite the fact that corporate contributions to global emissions and other negative environmental impacts dwarf those of households (e.g., Griffin and Heede, 2017), existing research has focused predominantly on consumer and voting behavior.

A recent study documents a positive relationship between early-life trauma experiences of CEOs and corporate social performance (CSP) during their tenures (O'Sullivan et al., 2021) using aggregate environmental, social, and governance (ESG) scores as a proxy. Such corporate ESG scores aim to capture a wide range of heterogeneous issues. We extend O'Sullivan et al. (2021)in two regards. First, we focus on a single major issue, climate change. Furthermore, we differentiate between hazard types that can be interpreted as manifestations of climate change, such as droughts and floods, and those unrelated to climate change, such as earthquakes. To our knowledge, there is no study to date that investigates the specific role of climate change-related (CC-related) hazard experiences on corporate climate policies.

Therefore, in this study, we address this gap by investigating the impact of CEOs' experiences of natural hazards, specifically those related to climate change, on corporate climate policies before and during their tenures. To overcome the joint-treatment problem of distinguishing CEOs from firms during recent hazard events, we collect data on natural hazards that occurred in CEOs' birth counties between five and 15 years after their births, with these events serving as proxies for individual natural-hazard experiences.[1] Specifically, we investigate the effect of CEO early-life natural-hazard experiences on CC-related corporate policies in terms of (i) managerial discretion during their active tenure and (ii) selection effects. Moreover, we conduct our analyses using two alternative proxies for corporate climate policies in order to triangulate the results and allow for more robust inferences.

Our study contributes to the literature in two main regards. First, our findings provide empirical support for the Upper Echelons Theory (Hambrick, 2007; Hambrick and Mason, 1984), which holds that corporate policies reflect the attributes, values, and experiences of

[1] This identification strategy has been proposed and validated by Bernile et al. (2017).

corporate executives. Specifically, our results on managerial discretion show that hazard experiences in early life are a positive predictor of corporate climate policies. Moreover, our results on self-selection dynamics indicate that the relationship between early-life hazard experiences and climate policies is manifested during a CEO's tenure and is not driven by systematic self-selection.

Second, we contribute to a growing body of literature in environmental psychology that explores the impact of psychological distance (PD) on climate-related decisions and the moderating role of biographical experiences (see Keller et al., 2022; McDonald et al., 2015, for a review). Despite the growing number of studies in this field, the results continue to be ambiguous. Whereas some studies report that reducing PD increases climate action (e.g., McDonald et al., 2015; Spence et al., 2012; Kollmuss and Agyeman, 2002), other studies report the opposite (e.g., McDonald et al., 2015; Brügger, 2013). In our study, we find that CEOs with hazard experiences implement more climate-friendly policies. Paradoxically, the positive relationship is observed only when including all hazard experiences and vanishes when limiting the analysis to hazard experiences attributable to climate change. Among CEOs in high-emitting industries, those with CC-related experiences appear to implement less climate-friendly policies relative to CEOs who have not experienced CC-related hazards. This suggests that the impact of climate-related experiences on climate action is complex and highly context-dependent.

2 Background and hypotheses

Many researchers have argued that climate change is a "distant phenomenon – temporally, socially, and geographically removed from our everyday experience" (McDonald et al., 2015, p. 110). There are several reasons for this. First, given the complex nature of climate change, many people may perceive a hypothetical distance due to feelings of uncertainty about whether climate change will affect their lives and, if so, how severely (Spence et al., 2012).

Second, while manifestations of climate change are increasingly noticeable, many people might perceive climate change to be temporally distant because its most severe consequences are expected to occur in the relatively distant future (Leiserowitz, 2005). Even if climate change is perceived as happening, one might still perceive it to be psychologically distant because of the spatial distance between the impacts of climate change and one's own location (Gifford et al., 2009). Finally, climate change may be perceived as being socially distant because the communities affected by climate change might differ from one's own background in terms of culture and ethnicity (Hart and Nisbet, 2012).

The literature on psychological distance suggests that personal experiences can motivate people to combat climate change by reducing the perceived distance between oneself and the impacts of climate change. Moreover, behavioral studies find that people use their own experiences as substitutes for objective evidence (Kahneman and Frederick, 2002; Tversky and Kahneman, 1974; Kahneman and Tversky, 1972). Personal exposure to the impact of climate change may reduce the hypothetical distance by reducing the perceived uncertainty about the severity of climate change. This phenomenon aligns well with the fact that people tend to learn more from experience than from intellectual reflection (Kolb, 2014; Kolb et al., 2001). In particular, experiences from childhood and early adolescence have the potential to have long-lasting impacts on peoples' lives and attitudes because people often evaluate new information through the lens of their cumulative biographical experiences (Nelson, 1993). Within the context of climate change, this dynamic implies that people overestimate how informative their own observations of the natural environment are when forming their beliefs about the urgency for climate action. If most decision-makers have not experienced the consequences of climate change, this heuristic will lead them to underestimate the need to act.

In support of this reasoning, a growing body of evidence is investigating the behavioral impact of witnessing extreme events in the natural environment on climate-related attitudes and decisions. The majority of these studies focus on how abnormal temperatures impact political attitudes toward climate change or belief in climate change (Zaval et al., 2014; Egan and Mullin, 2012; Joireman et al., 2010). There is a relative consensus that, in addition to an increase in long-term average temperatures, climate change will also exacerbate the frequency and severity of certain types of natural hazards, such as droughts, floods, and hurricanes. Reflecting this link, occurrences of natural hazard events have also been found to raise awareness of climate change (Sisco et al., 2017; Kirilenko et al., 2015; Rudman et al., 2013). Notably, natural hazards not only cause ecological destruction, but they also have catastrophic effects on affected communities, "interfering with a wide range of human rights, including the rights to life, health, food, housing, water, development and freedom of movement" (UN OHCHR, 2018, para. 3). Hence, their catastrophic impacts potentially lead to traumatic experiences, which can have long-lasting and pronounced impacts on personal development (see O'Sullivan et al., 2021, for a review on the effect of traumatic experiences on decision-making).

While many studies on the attitude-behavior gap focus on personal decisions and attitudes, decisions are highly context-dependent (Cohn et al., 2014; Ellingsen et al., 2012; Liberman et al., 2004). Hence, shifts in the private attitudes of individuals do not necessarily permeate their professional decisions. Thus, a growing body of literature investigates the impact of hazard experiences specifically on decisions made by CEOs (e.g., Choi et al., 2023; Chen et al., 2021; O'Sullivan et al., 2021; Bernile et al., 2017). The study most closely related to ours is O'Sullivan et al. (2021). In that study, the authors report that early-life trauma for individuals who go on to become CEOs is positively related to CSP during their tenures. The authors conclude that boards may want to consider the early-life experiences of possible candidates when hiring CEOs, but they do not test this conjecture. Despite growing interest in the topic, we are not aware of any study that investigates how climate-related experiences affect climate-related choices in an organizational setting. Moreover, there is limited existing knowledge on whether CEOs end up joining different firms depending on their biographical experiences.

Managerial discretion. The Upper Echelons Theory holds that an organization is a reflection of the individual characteristics, skills, and values of its top executives (Hambrick, 2007; Hambrick and Mason, 1984). Indeed, empirical studies show that managerial characteristics, skills, and preferences explain a large amount of between-firm variations with respect to corporate policies (Bromiley and Rau, 2016; Graham et al., 2012; Bamber et al., 2010; Bertrand and Schoar, 2003). In particular, CEO characteristics and values reportedly affect a firm's ESG policies (Hegde and Mishra, 2019; Oh et al., 2016; Lewis et al., 2014; Huang, 2013; Chin et al., 2013). This suggests that changes to a CEO's environmental and social preferences induced by natural hazard experiences will also affect the corporate climate policies they promote during their tenures.

However, empirical tests of how shifts in CEO preferences induced by natural hazards affect corporate strategies are likely to suffer from endogeneity problems. This is because natural hazards are likely to affect not only CEOs but also the operations of the firms they work for, making it difficult to identify the underlying causes for changes in climate policies when hazards occur during their tenures. For instance, natural hazards may affect market conditions or destroy critical production facilities (Raschky, 2008), diminishing a firm's total assets. On the one hand, executives might respond to such negative financial shocks by cutting back on non-essential expenditures or by delaying modernization projects, possibly resulting in deteriorating environmental performance in subsequent years (Waddock and Graves, 1997; Kinder and Domini, 1997). On the other hand, managers may have to replace destroyed facilities with more up-to-date models, coincidentally modernizing a firm's environmental policies in the process. The variety of possible causes makes it challenging to establish a causal relationship between exposure to natural hazards and corporate climate policies.

By focusing on experiences during childhood and early adolescence, it is possible to overcome the joint-treatment problem and disentangle the treatment of CEOs from the treatment of the firm. Despite the long time span between treatment events and managerial decisions, a growing number of studies show that early-life experiences have long-lasting and significant impacts on CEOs' decisions, which manifests in corporate policies during their tenures (e.g., Chen et al., 2021; Bernile et al., 2017; Malmendier et al., 2011).

O'Sullivan et al. (2021) argue that hazard experiences during childhood and early adolescence specifically have potentially traumatic impacts on CEO's lives. This can trigger post-traumatic growth, leading to CEOs making more responsible decisions during their tenures. Given this general relationship between early-life experiences of CEOs and corporate responsibility during their tenures, we expect that an increase in personal responsibility will manifest in more climate-friendly policies.

Hypothesis 1 (Managerial discretion, general). *CEOs with early-life hazard experiences are likely to adopt more climate-friendly corporate policies, as evidenced by higher climate scores during their tenures relative to an organization's pre-tenure scores.*

The literature on psychological distance and relevant heuristics provides an alternative angle on the formative mechanism. Specifically, it is frequently argued that hazard experiences reduce the perceived distance towards climate change experienced by CEOs (McDonald et al., 2015; Spence et al., 2012). An important precondition for this dynamic is that one's experiences of natural hazards are attributable to climate change. While some types of natural hazards, such as heat waves and floods, are commonly associated with climate change, others, such as earthquakes, appear to be unrelated. Hence, the psychological distance argument implies that CC-related hazard experiences will have a positive incremental effect, while non-CC-related hazard experiences will not have this effect.

Hypothesis 2 (Managerial discretion, CC-related). *CEOs with CC-related hazard experiences are likely to adopt more climate-friendly corporate policies, as evidenced by higher climate scores during their tenures relative to an organization's pre-tenure scores.*

Acknowledging that corporate emissions are mainly concentrated in a few high-emitting industries, corporate climate policies are particularly material, and hence, strategically important, for firms in those industries. This implies that if CC-related hazard experiences motivate CEOs to combat climate change, then the differences will be particularly pronounced in high- emitting industries.

Hypothesis 3 (Managerial discretion, high-emitting industries). *The positive relationship between CEO CC-related hazard experiences and climate-friendly corporate policies, as evidenced by higher climate scores, will be particularly pronounced in high-emitting industries.*

Self-selection. It is important to acknowledge that CEO characteristics, skills, and values may not only affect decisions made during a CEO's tenure but might also already play a key role at the stage of appointing a CEO (Guenzel and Malmendier, 2020; Wales et al., 2013). Jovanovic (1979) argues that the productivity of employees is in part determined by the quality of the employee-employer match. In other words, CEOs can be expected to be more successful in firms that provide a good fit for their particular skills, talents, and values. This so-called Job Matching Theory is supported by several empirical studies (e.g., Allgood et al., 2012; Allgood and Farrell, 2003; Miller, 1991). Arguably, one of the roles of the board is thus to match the "right" CEO to a firm's unique characteristics in order to maximize corporate financial performance (Gibbons and Murphy, 1992; Miller, 1991). Indeed, a strand of literature suggests that self-selection is evident in the decision-making processes of top executives (see Kai and Prabhala, 2007, for a review). Since early-life experiences are formative events in an individual's personal development, boards might consider these experiences when selecting suitable candidates (O'Sullivan et al., 2021). If hazard experiences do trigger shifts in CEO preferences for climate action, it seems reasonable to expect that these preferences will manifest not only in decisions during a CEO's tenure but also in their choice of employer.

The job-matching argument suggests that CEOs who assign higher importance to climate action will perform better in organizations where climate action is possible and valued. Moreover, by refusing to work for a company that has poor climate policies, a CEO could create incentives for that organization to improve their policies, in order to retain or gain access to the best managerial talent. Furthermore, choosing to work for a firm with poor climate policies might cause cognitive dissonance for a CEO who assigns high importance to climate action because it could conflict with the CEO's self-image. If this argument holds, CEOs with higher levels of awareness of climate change due to their CC-related hazard experiences will prefer to work for firms with more climate-friendly policies.

Hypothesis 4 (Self-selection, job matching). *CEOs with CC-related hazard experiences will be more likely to join firms with more climate-friendly corporate policies, as evidenced by higher climate scores.*

The argument is particularly plausible for high-emitting industries where a CEO might face an ethical dilemma between corporate profits and costly efforts to mitigate emissions and adapt to climate change (Van den Hove et al., 2002). Corporate emissions are concentrated in a few high-emitting sectors. If CC-related experiences amplify a CEO's preference for climate action, CEOs with early-life exposure to CC-related hazards will be even more sensitive to climate scores when joining firms in high-emitting industries.

Hypothesis 5 (Self-selection, high-emitting industries). *The positive relationship between a CEO's CC-related hazard experiences and an organization's pre-tenure climate policies, as evidenced by higher climate scores, will be particularly strong in high-emitting industries.*

3 Methodology

3.1 Data and variable description

We estimate the relationship between a CEO's natural hazard experiences and corporate climate policies during (H1, H2, AND H3, MANAGERIAL DISCRETION) and before their tenure (H4 AND H5, SELF-SELECTION).

Dependent variables. Since corporate climate policies are difficult to quantify and compare, we rely on climate-related scores from well-known rating providers. We use KLD social ratings and ASSET4 ESG scores, which have both been employed in various previous research studies.

KLD. KLD's social ratings, which have been used in numerous studies, provide binary indicators for strengths and concerns across a wide range of environmental, social, and governance issues. For the *KLD Climate Score*, we include four selected strengths and concerns that capture important dimensions related to climate change. In this calculation, we subtract cumulative concerns from cumulative strengths as proposed by previous studies (e.g., Chin et al., 2013), meaning that a higher number indicates a better performance. Our indicator contains two strengths, *Climate Change - Carbon Emissions* (ENV-str-D) and *Natural Resource Use - Water Stress* (ENV-str-H), as well as two concerns, *Climate Change - Energy and Climate Change* (ENV-con-F) and *Water Stress* (ENV-con-K). [2]

$$
\begin{aligned}
\text{KLD Climate Score}_{\text{i,t}} \equiv & \sum^{S}(CarbonEmissions_{i,t} + WaterStress_{i,t}) \\
& - \sum^{C}(Energy\&ClimateChange_{i,t} + WaterStress_{i,t})
\end{aligned}
\tag{1}
$$

To compare our results for climate scores against those of aggregate ESG scores, we also construct an aggregate score. The methodology for calculating the aggregate KLD score, as

[2] Other indicators in relation to climate change have very little coverage in our sample.

well as any corresponding analyses, can be found in Appendix A.2.

ASSET4. As an alternative proxy, we use corporate emission scores from the ASSET4 ESG Database. Like KLD's social ratings, *ASSET4 ESG Scores* have been used as a proxy for various aspects of corporate ESG policies, including those related to climate change. The rating provider claims that the scores are based on all publicly available information sources, including annual reports, company websites, NGO information, stock exchange filings, and corporate ESG reports, as well as on news sources (Thomson Reuters Eikon, 2018). Instead of KLD's binary system, the ASSET4 score is composed of a letter score, ranging from A+ to D-, and a percentage scale from zero to 100. In addition to annual as a proxy for corporate climate policies, we conduct robustness analyses for ASSET4 aggregate ESG scores that are analogous to our analyses for KLD aggregate scores (see Appendix A.3 Table A3 and Appendix A.4 Table A5).

Explanatory variables. In the construction of our explanatory variable, we largely follow the approach outlined and validated in Bernile et al. (2017). First, we start by obtaining the names of CEOs who worked in one of the firms in the S&P1500 from 1991 to 2018 from Compustat's Execucomp database. For each CEO, we add information on birth date, birth state, and county from Marquis Who's Who and the US Executive Compensation database via NNDB.com or conduct manual searches via Google when necessary. In the next step, we exclude foreign-born CEOs, those with missing information on date of birth or county, as well as those CEOs who cannot be matched unambiguously to a firm and the respective period during which they were hired. As a third step, we collect county-level records on natural hazards occurring on US territory between 1900 and 2017, including dates, reported numbers of fatalities, and estimated amounts of US-Dollar property damage (price-adjusted for 2017). Our data include avalanches, coastal events, droughts, earthquakes, floods, fog, hail, heat, hurricanes and other tropical storms, landslides, lightning, severe storms, tornados, tsunamis and seiches, volcanic eruptions, wildfires, wind, and winter weather.

Most data points are retrieved from SHELDUS^{TM} from the University of South Carolina, which reports data from 1960 through 2017. For natural hazards that occurred prior to 1960, we hand-collect data from records from relevant online archives for natural hazards in the US, specifically the United States Geological Surveys (USGS) and the National Geophysical Data Center (NGDC) or by manual web searches. We aggregate the number of fatalities caused by natural hazards in the CEO's birth county between 5 years and 15 years after the CEO's birth year as a proxy for the severity of individual experiences.[3] Moreover, we normalize the number of total fatalities by the population size of the respective county. Henceforth, our explanatory variable for aggregate hazard experiences is defined as follows:

$$\text{Hazard Exp.}_{\text{i}} \equiv \begin{cases} 0; & \text{if } \sum_{t_5}^{t_{15}} fatalities_{\text{it}} = 0 \\ 1; & \text{if } \sum_{t_5}^{t_{15}} fatalities_{\text{it}} > 0 \end{cases} \tag{2}$$

where $fatalities_{it}$ represents total fatalities per 10T capita in the birth country of CEO i in the year t between year $t_5 = birth\ year + 5$ and $t_{15} = birth\ year + 15$.

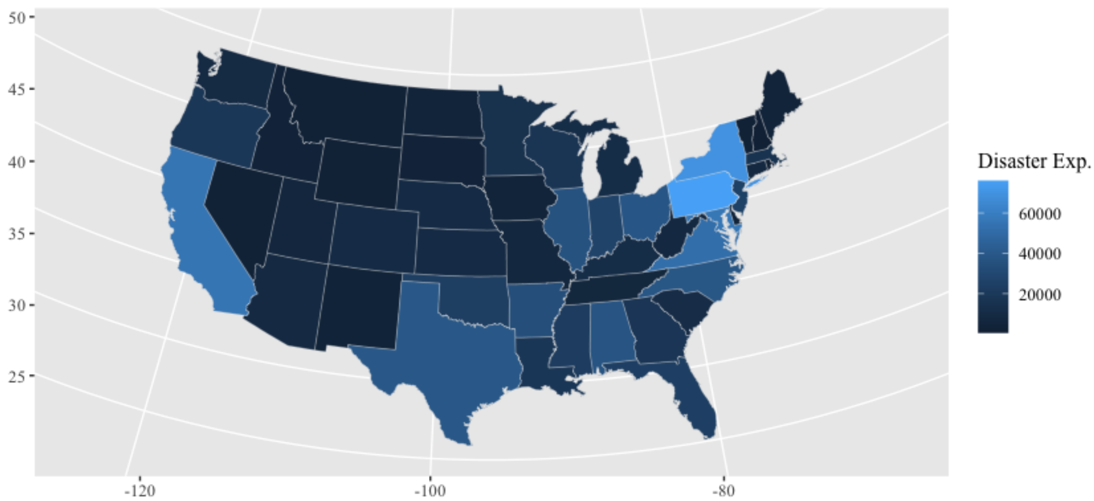
In addition, we classify hazard events into two event types: those that are exacerbated by climate change ($CC = 1$) and those that have no established connection with climate change ($CC = 0$). To this end, we assume a connection whenever a link is acknowledged in the relevant literature (e.g., Lee et al., 2023; Purohit and Rout, 2023; Hao et al., 2023; Torregrosa et al., 2014; Anderson and Bausch, 2006; Van Aalst, 2006). The classification is reported in the Appendix A.1 Table A1. Based on this classification, we compute the following measure of a CEO's early-life exposure to CC-related hazard events:

[3] This procedure implies an assumption that the majority of CEOs grew up close to their respective birth places. Bernile et al. (2017) test this assumption by comparing birth places to issuance places for CEOs' first security numbers and are able to support its validity. Since our data set is based on the same raw data used by Bernile et al. (2017) and O'Sullivan et al. (2021), the verification conducted by previous authors establishes the validity of the assumption for our study.

$$\text{CC-related Exp.}_{\text{i}} \equiv \begin{cases} 0; & \text{if } \sum_{t_5}^{t_{15}} CC * fatalities_{\text{it}} = 0 \\ 1; & \text{if } \sum_{t_5}^{t_{15}} CC * fatalities_{\text{it}} > 0 \end{cases} \tag{3}$$

where $fatalities_{it}$ represents total fatalities per 10T capita in the birth country of CEO i in the year t between year $t_5 = birth\ year + 5$ and $t_{15} = birth\ year + 15$.

Figure 1: Fatalities caused by Natural Hazards by US State from 1919 to 1988

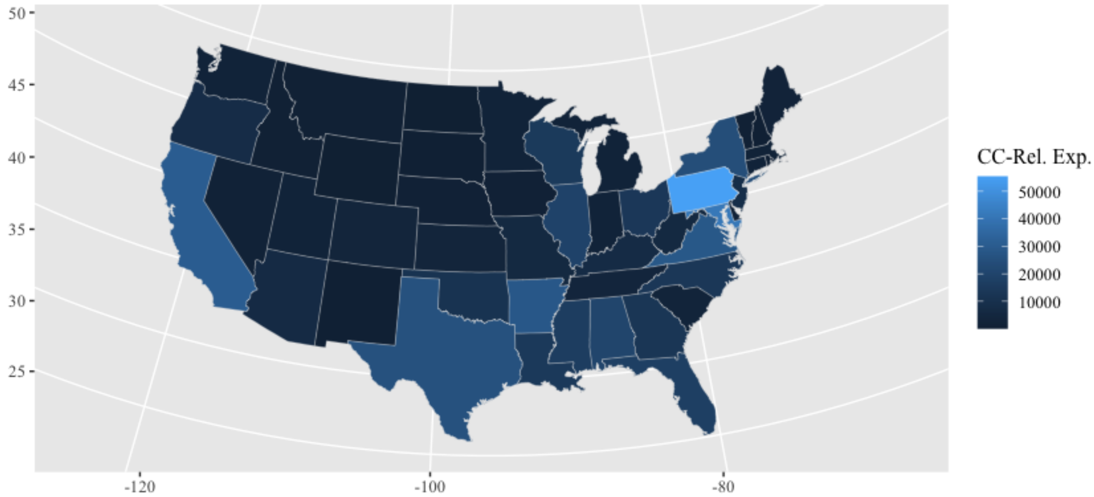


Notes. This figure depicts the US Map shaded for each state by their accumulated number of fatalities caused by hazards from 1919 to 1988.

For a visual comparison of CC-related Natural Hazards and Natural Hazards by US State, see 1 and Figure 2.

Control variables. To control for factors that influence corporate climate policies, we include four different gauges. First, we include *Total Assets* to measure the size of a firm. Second, we calculate *ROA* as net income divided by total assets, which represents a company's profitability. Third, we control for *Leverage* defined as total debt divided by total equity as an indicator of a firm's risk. And fourth, we include the *Cash to Assets ratio*, defined as a company's cash holdings divided by total assets, in order to measure a company's

Figure 2: Fatalities caused by CC-related Natural Hazards by from 1919 to 1988



Notes. This figure depicts the US Map shaded for each state by their accumulated number of fatalities caused by CC-related hazards from 1919 to 1988.

liquidity.[4] Moreover, we control for CEO age to account for generational differences.

We also gather information about the sector distribution in our sample. We obtain the Global Industry Classification Standard (GICS) Industry Group classification developed by Standard & Poor's and MSCI. WWe classify those 24 industry groups as being high- or low-emitting in terms of greenhouse gas emissions. In this vein, 11 of 24 industry groups are classified as high-emitting. We base our categorization on the sectoral greenhouse gas emissions by IPCC data and cross-reference this data with further literature (e.g., Liu et al., 2023; Teske et al., 2022a,b; European Environment Agency, 2016).

[4]In addition, we collect information on *Liabilities* as a further risk indicator, as well as *Book-to-market-ratio* and *Tobins-Q* as proxies for profitability and a firm's value. Moreover, we also retrieve data on *Debt* and *Equity* to calculate the above measures and validate the numbers from Compustat's database. Given the small sample size, we include only the most relevant controls. Preliminary analyses have shown that most of the firm-specific variables do not explain a noticeable proportion of the variance in the level of corporate climate policies. Neither were regression coefficients significant, nor did R^2 increase as these variables were added to the models. Several firm characteristics are highly correlated with total assets and have not been included in our regressions to avoid multi-collinearity issues.

3.2 Estimation strategy

Managerial discretion model. Since our aim is to estimate the relationship between a CEO's hazard experiences and climate policies adopted during their tenure, we include an organization's pre-tenure climate scores as a control variable. Additionally, it is reasonable to assume that certain events, e.g., economic crises or regulatory changes, have an impact on all firms. Moreover, corporate climate scores exhibit a positive time trend that may bias our results. By including time-fixed effects in our model, we are able to control for unobserved variables that are constant across individuals but vary over time. Furthermore, it is reasonable to assume that CEOs' preferences regarding firms' climate policies can affect their willingness to join a particular firm. For instance, CEOs with pronounced preferences regarding climate-friendly policies may refuse to work for firms that have poor climate policies. By including a score for a firm's corporate climate policies before a CEO's tenure at that firm, i.e., the *Prior Score* as a time-invariant firm control, we are able to control for and measure possible self-selection effects. To control for time-variant firm characteristics, we include commonly used firm controls, as described above. Based on this reasoning, we estimate the following regression model:

$$\begin{aligned}\mathrm{Score}_{\mathrm{i,t}} \sim \mathrm{Hazard\ Exp.}_{\mathrm{i}} * \mathrm{High\text{-}emitting\ Ind.}_{\mathrm{i}} + \mathrm{Prior\ Score}_{\mathrm{i}} \\ + \mathrm{Firm\ Controls}_{\mathrm{i,t}} + \mathrm{CEO\ Controls}_{\mathrm{i,t}} + \theta_{\mathrm{t}} + \epsilon_{\mathrm{i,t}},\end{aligned} \tag{4}$$

where *Score* represents firm i's aggregate or climate related score in year t during a CEO's tenure. In addition to our explanatory variables, we include firm controls and CEO controls. θ captures time-fixed effects and ϵ is the error term. In addition to climate scores, we estimate the same model for aggregate ESG scores to identify whether the pattern is unique for corporate climate scores.

Self-selection model. To investigate self-selection effects, we require a measure of corporate climate policies that is not yet affected by the actions of a given CEO but is sufficiently close to a CEO's appointment to have been relevant in the recruitment process. To this aim, we define *Prior Score* as a firm's corporate climate policy score in the year prior to a CEO's appointment or, if that information is not available, the start year of a CEO's employment. By definition, this measure is independent of any corporate climate policies implemented by the CEO during her tenure. As CEO recruitment is a lengthy process, *Prior Score*also represents the firms' climate policies during the recruitment period for the CEO. As outlined in the previous section, we are interested in the relationship between *Prior Score* Score and a given CEO's experiences with early-life natural hazards. Therefore, we include the *Hazard Experience* as our independent variable of interest. Based on the above reasoning, we estimate the following regression model:

$$\begin{aligned} \text{Prior Score}_{\text{i}} &\sim \text{Hazard Exp.}_{\text{i}} * \text{High-emitting Ind.}_{\text{i}} \\ &+\text{Firm Controls}_{\text{i}} + \text{CEO Controls}_{\text{i}} + \epsilon_{\text{i}} \end{aligned} \tag{5}$$

where *Prior Score* refers to firm *i's* climate scores prior to the CEO's tenure. In addition to our explanatory variable, we include firm controls and CEO controls. $\epsilon_{\text{i,t}}$ is the error term.

We test the same models described in this section as robustness checks for aggregate ESG scores, instead of climate scores, as a proxy for climate policies. The results are reported in Appendix A.3 and Appendix A.4.

4 Results

4.1 Hypotheses H1, H2 and H3: Managerial discretion

Table 1 and Table 2 report results for our managerial discretion hypotheses from time-fixed effects regressions with annual climate scores, i.e., *KLD Climate Score* and *ASSET4 Emissions Score*, as our dependent variables as proxies for corporate climate policies.

The findings presented in Table 1 and Table 2 clearly demonstrate a significant positive correlation between *Hazard Experiences* and the climate scores during a CEO's tenure in both the KLD and ASSET4 regression models. In both tables, the coefficients for *Hazard Experiences* exhibit statistical significance levels of 1% and 5%, and the corresponding F-statistics are also highly significant. Hence, we accept Hypothesis H1. On average, CEOs with hazard experiences are more inclined to implement climate-friendly policies during their tenures, as indicated by higher climate scores compared to the organization's pre-tenure scores.

Furthermore, Table 1 and Table 2 provide insights from regression models examining the relationship between *CC-Related Experience* and the climate scores. In Column (2) of both tables, the coefficients for *CC-Related Experience* are found to be statistically insignificant. As such, we cannot extend the finding of Hypothesis H1 to experiences only related to climate change, which is an interesting finding.

However, in Column (4), the results reveal a robust and statistically significant positive relationship between *CC-Related Experience* and the climate scores, namely, *KLD Climate Score* and *ASSET4 Emissions Score*. Notably, the regression model in Column (4) takes into consideration the conditional relationship with *High-Emitting Industries* an interaction-term in comparison to the model in Column (2). Additionally, the single coefficient for *High-Emitting Industries* s also positively related to the dependent variables in both tables. However, the direction of the relationship changes when both variables interact (*High-Emitting Industries* and *CC-Related Experience*). In summary, we observe a robust positive relationship between climate scores and *Hazard Experiences* for both samples. Hence, these results provide further support for Hypothesis H1.

CEOs with CC-related experiences tend to adopt less climate-friendly policies during their tenures when working in high-emitting industries, as evidenced by lower climate scores relative to an organization's pre-tenure performance, compared to CEOs in other industries. Hence, it appears that the null effect in Column (2) of Table 1 and Table 2 and the negative incremental effect in Column (3) is primarily driven by CEOs in high-emitting industries. Importantly, these results are robust to our choice of proxy (KLD and ASSET4 sample). In summary, CEOs with *CC-related Experiences* implement less climate-friendly policies than CEOs with non-CC-related hazard experiences. Hence, we reject Hypothesis H2 (Managerial discretion, CC-related). Moreover, CEOs with *CC-related Experiences* appear to adopt less climate-friendly policies when working in high-emitting industries compared to CEOs without *CC-related Experience*. Hence, we reject Hypothesis H3 (Managerial discretion, high-emitting industries).

We also conduct the same regression models for the aggregate ESG scores of both samples (KLD and ASSET4) as their dependent variable. As depicted in Appendix A.3 Table A2 and Table A3, the main difference from the models presented in Table 1 and Table 2 is that we replaced the climate scores, namely the *KLD Climate Score* and *ASSET4 Emissions Score* with aggregate ESG scores. This robustness test serves to confirm the robustness of the positive relationship between *Hazard Experiences* and the dependent variables. While we corroborate previous findings for the relationship between aggregate hazard experiences and aggregate ESG scores, we do not find evidence for a relationship between *CC-Related Experience* and aggregate ESG scores.

Table 1: Time-fixed Effects Regressions for KLD Climate Scores

	KLD Climate Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	0.104**		0.225***	
	(0.042)		(0.056)	
CC-Related Exp.		−0.025	−0.141***	0.092**
		(0.033)	(0.044)	(0.044)
High-Emitting Ind.				0.198***
				(0.050)
High-Emitting Ind.*CC-Related Exp.				−0.220***
				(0.056)
Prior Score	0.603***	0.605***	0.616***	0.624***
	(0.028)	(0.028)	(0.028)	(0.029)
Ln(Total Assets)	0.030***	0.030***	0.032***	0.028***
	(0.006)	(0.006)	(0.006)	(0.006)
ROA	0.718***	0.761***	0.750***	0.788***
	(0.137)	(0.137)	(0.137)	(0.137)
Ln(Cash to Assets)	−0.0004	−0.001	−0.0002	−0.001
	(0.008)	(0.008)	(0.008)	(0.008)
CEO Age	0.005**	0.001	0.004*	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Observations	1,793	1,793	1,793	1,793
R^2	0.232	0.230	0.237	0.237
Adjusted R^2	0.219	0.217	0.223	0.223
F Statistic	88.820***	87.644***	78.031***	68.353***
Time-fixed Effects	Yes	Yes	Yes	Yes

Notes. This table reports time-fixed effects regression results for the relation between CC-related CEO early-life hazard experiences and the annual *KLD Climate Score* which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

Table 2: Time-fixed Effects Regressions for ASSET4 Emissions Scores

	ASSET4 Emissions Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	16.357***		24.893***	
	(2.550)		(3.333)	
CC-Related Exp.		2.224	−9.513***	9.680***
		(1.884)	(2.416)	(2.572)
High-Emitting Ind.				15.441***
				(3.466)
High-Emitting Ind.*CC-Related Exp.				−15.053***
				(3.600)
Prior Score	0.632***	0.627***	0.633***	0.614***
	(0.022)	(0.023)	(0.022)	(0.023)
Ln(Total Assets)	1.865***	2.179***	1.777***	2.604***
	(0.426)	(0.431)	(0.423)	(0.461)
ROA	0.153	0.179	0.168	0.187*
	(0.112)	(0.114)	(0.111)	(0.113)
Ln(Cash to Assets)	0.667	0.741*	0.756*	0.775*
	(0.432)	(0.441)	(0.430)	(0.451)
CEO Age	−0.121	−0.292***	−0.167*	−0.207**
	(0.093)	(0.094)	(0.093)	(0.096)
Observations	1,029	1,029	1,029	1,029
R^2	0.578	0.561	0.584	0.570
Adjusted R^2	0.571	0.554	0.577	0.562
F Statistic	230.707***	215.628***	202.798***	167.055***
Time-fixed Effects	Yes	Yes	Yes	Yes

Notes. This table reports time-fixed effects regression results for the relation between CC-related CEO early-life hazard experiences and the annual *ASSET4 Emissions Score* which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

4.2 Hypotheses 4 and 5: Self-selection

Table 3 and Table 4 report the results for our self-selection hypotheses from OLS regressions employing prior annual climate scores, specifically *Prior KLD Climate Scores* and *Prior ASSET4 Emissions Scores*, as our dependent variables. Our objective here is to explore the empirical link between CEOs' hazard experiences and organizations' climate policies prior to their tenure.

The findings displayed in Table 3 reveal a clear picture regarding the relationship between *Hazard Experiences* and prior climate scores. Columns (1) and (2) of Table 3 suggest a positive and significant relationship between our variables of interest and *Prior KLD Climate Scores* (β = 0.217 (p<5%) for *Hazard Experiences* and β = 0.186 (p<5%) for *CC-Related Experience*). Moreover, the results in Model (4) from the same table indicate that, in the KLD sample, CEOs tend to join firms with higher *Prior KLD Climate Scores* if they join firms in high-emitting industries. As for the ASSET4 sample, Table 4 shows no significant results for our variables of interest, which might be attributed to the small ASSET4 sample that only includes 180 CEOs. The directions of relevant coefficients, however, suggest the opposite relationship.

Taking into account the evidence from both samples, the findings provide weak support for the idea that CEOs with hazard experiences, both CC-related and non-CC-related, are somewhat more likely to join firms with more climate-friendly policies, specifically when firms operate in high-emitting industries. However, the results are not robust and even mildly contradictory across our two samples. While we find statistical support for self-selection in Table 3 for the KLD sample, the results in Table 4 do not indicate any significant relationship between our independent variables and *Prior ASSET4 ESG Scores* with most relevant coefficients having opposite signs. Therefore, we conclude that our findings are not robust to our choice of proxy. In summary, we do not observe consistent relationships between CEOs' hazard experiences and the pre-tenure climate scores of the firms they join. Since we do not find consistent support for any of our self-selection hypotheses, we reject both Hypothesis H4 (Self-selection, job matching) and Hypothesis H5 (Self-selection, high-emitting industries).

In addition, we perform robustness checks to encompass the combined ESG scores of both data sets (KLD and ASSET4). These extended analyses, featured in Appendix A.4 Table A4 and Table A5, mirror our approach for testing Hypotheses H4 and H5, replacing climate scores with aggregate ESG scores. However, the results do not reveal any statistically significant relationships, except for a noteworthy observation in Table A5, where, in Model (4), the individual coefficient for *High-Emitting Industries*displays a positive significant relationship with the dependent variable, whereas the coefficient for the interaction term with *CC-Related Experience* is negative. Again, the result is only observed in one sample.

Table 3: OLS Regressions for Prior KLD Climate Scores

	Prior KLD Climate Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	0.217**		0.132	
	(0.089)		(0.136)	
CC-Related Exp.		0.186**	0.099	0.045
		(0.078)	(0.119)	(0.109)
High-Emitting Ind.				−0.230**
				(0.117)
High-Emitting Ind.*CC-Related Exp.				0.246*
				(0.135)
Ln(Total Assets)	0.030**	0.029*	0.029*	0.029*
	(0.015)	(0.015)	(0.015)	(0.015)
ROA	0.351	0.375	0.353	0.330
	(0.275)	(0.274)	(0.275)	(0.274)
Ln(Cash to Assets)	0.049**	0.051**	0.050**	0.048**
	(0.023)	(0.023)	(0.023)	(0.023)
CEO Age	0.007	0.006	0.008	0.006
	(0.006)	(0.006)	(0.006)	(0.006)
Constant	−0.879**	−0.770*	−0.893**	−0.617
	(0.433)	(0.414)	(0.433)	(0.420)
Observations	270	270	270	270
R^2	0.057	0.056	0.059	0.070
Adjusted R^2	0.039	0.038	0.038	0.045
F Statistic	3.191***	3.137***	2.770**	2.821***

Notes. This table reports OLS regression results for the relation between CC-related CEO early-life hazard experiences and the *Prior KLD Climate Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

Table 4: OLS Regressions for Prior ASSET4 Emissions Scores

	Prior ASSET4 Emissions Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	−4.895		−7.712	
	(8.308)		(10.673)	
CC-Related Exp.		−0.226	3.178	4.182
		(5.868)	(7.532)	(7.851)
High-Emitting Ind.				15.352
				(10.627)
High-Emitting Ind.*CC-Related Exp.				−9.469
				(11.235)
Ln(Total Assets)	9.739***	9.667***	9.783***	10.361***
	(1.249)	(1.244)	(1.256)	(1.290)
ROA	0.846**	0.821**	0.844**	0.832**
	(0.336)	(0.335)	(0.337)	(0.334)
Ln(Cash to Assets)	0.983	0.999	0.970	1.534
	(1.347)	(1.348)	(1.351)	(1.378)
CEO Age	0.061	0.124	0.079	0.236
	(0.319)	(0.316)	(0.322)	(0.320)
Constant	−103.890***	−110.481***	−105.756***	−133.571***
	(28.363)	(27.981)	(28.772)	(30.364)
Observations	180	180	180	180
R^2	0.286	0.285	0.287	0.301
Adjusted R^2	0.265	0.264	0.262	0.272
F Statistic	13.939***	13.843***	11.591***	10.556***

Notes. This table reports OLS regression results for the relation between CC-related CEO early-life hazard experiences and the *Prior ASSET4 Emissions Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

5 Discussion and conclusion

A growing body of scientific evidence documents the long-lasting effects of climate change and its consequences on the global ecosystem and its inhabitants. This study contributes to this literature by investigating the long-term behavioral impact of early-life hazard experiences on corporate climate policies of CEOs during their active tenures. We find that hazard experiences are positively related to corporate climate scores. The relationship is strong and highly statistically significant. However, when we limit the analysis to CC-related hazard experiences, the positive relationship vanishes. This mitigating effect appears to be driven primarily by CEOs in high-emitting industries.

With our study, we contribute to the literature on the Upper Echelons Theory, which highlights the decisive role of top executives in shaping corporate policies. Our results provide further empirical support for the conjecture that biographical experiences of CEOs can be important determinants of their professional decisions. If organizational decisions are highly influenced by the specific people who occupy its executive offices, psychological dynamics affecting individual attitudes, preferences, and values are likely to impact organizational decisions. This emphasizes the need to focus on people as the relevant unit of analysis to understand organizational behavior, bridging the gap between the managerial and psychological literature.

Regarding the psychological dynamics, our findings contradict the common claim that CC-related experiences in early life induce people to make more climate-friendly choices – in fact, we find the counter-intuitive effect of CC-related experiences. While this argument is plausible and intuitively appealing, more recent studies have argued that reducing PD through relevant experiences is only likely to shift attitudes among decision-makers who do not have strong prior convictions. For instance, climate deniers are unlikely to make up their minds even if the consequences of climate change intensify. At the other end of the spectrum, those already concerned about climate change may feel overwhelmed by experiencing its catastrophic impacts, triggering feelings of helplessness and anxiety, leading to an inaction on climate change. Reducing PD may exacerbate anxiety levels and cause people to avoid climate change as a coping strategy. Furthermore, corporate contributions to climate change are a systemic problem that requires coordinated action. If people lose hope in humanity's ability to coordinate successfully, they may adopt a cynical "devil-may-care" attitude, undermining their willingness to combat climate change. Arguably, these dynamics resonate with our finding that CEOs in high-emitting industries do not adopt more climate-friendly policies during their tenure if they were exposed to fatal CC-related hazards during their early lives. In any case, our findings highlight that the underlying psychological dynamics are highly contextual and complex. Beyond psychological factors, within high-emission industries, initiatives aimed at addressing climate change, such as decarbonization strategies, often incur substantial costs that may challenge the fundamental business model. While the results in our study even indicate a slightly negative relationship between CC-related experiences and climate policies for CEOs in high-emitting industries, further research is needed to investigate the behavioral impact of CC-related experiences on climate action in organizational decision-making in more detail. One potential explanation is that managers with such early-life experiences follow a self- legitimizing strategy: climate change was there all along, we cannot change the system, we should not engage in such costly mitigation strategies.

Interestingly, our findings on self-selection reveal ambiguous results. While we find some support for value-matching in CEO hiring for the KLD sample, we find no pertinent relationship in the ASSET4 sample. In addition to methodological sources of discrepancies, which will be discussed below, the behavioral implications of climate-related experiences within the context of selection are not straightforward. Whereas the job-matching theory suggests a positive relationship, the psychological distance argument suggests that relevant experiences amplify the willingness to act. Hence, if early-life hazard experiences trigger moral growth and motivate CEOs to push for change, it seems similarly plausible to expect that CEOs will consider the need and potential for change rather than the compatibility of values in the status quo. Since firms with poor climate policies and firms in high-emitting industries have the greatest need and potential to make a positive contribution, CEOs who are motivated by generating impact may specifically choose firms because of these characteristics. Thus, in a mixed sample of value matchers and impact seekers, we would expect ambiguous results.

An important limitation of our study is that we rely on birth places and birth years as proxies for CEOs' locations during their childhood and early adolescence. While this approach has been validated by previous scholars, specifically Bernile et al. (2017) who originally proposed this identification strategy, O'Sullivan et al. (2021) point out that the places where a person grows up matter most for the formative mechanism. In our study, we rely on the original mapping strategy proposed by Bernile et al. (2017) and therefore inherit the possible limitations of this approach. While we acknowledge the possibility that CEOs moved elsewhere with their families during their early lives, more recent literature on CEO locality (e.g., Lai et al., 2020) suggests that CEOs remain closely attached to their birth places even in their adult lives. Hence, even if CEOs did not spend their childhood and adolescence in their birth places, it is nevertheless likely that they will maintain important social ties with these regions. Therefore, CEOs may still have been exposed to the consequences of severe natural hazards close to their birth places even if their parents no longer resided in the area.

A second limitation of our work lies in our operationalization of corporate climate policies. Due to well-known challenges in collecting reliable and comparable data on corporate climate strategies, we rely on third-party scores as the next-best alternative. Arguably, this approach represents one of the most common strategies to operationalize various dimensions of corporate ESG policies. In recent years, however, the validity of third-party ESG scores, and by implication corporate climate scores, has been questioned (e.g., Berg et al., 2022; Chatterji et al., 2016; Dorfleitner et al., 2015). To partly address these concerns, we test our hypotheses using two alternative proxies for corporate climate policies based on KLD social ratings and ASSET4 ESG scores, which have both been used in numerous studies (e.g., Albuquerque et al., 2019; Chatterji et al., 2009; Waddock and Graves, 1997). Specifically, with respect to the KLD sample, there are also concerns about the empirical validity of an aggregated measure combining binary strengths and concerns without testing the validity of the factor aggregation (Mattingly and Berman, 2006). Arguably, the fact that we find strong and highly consistent evidence for managerial discretion across both samples despite the vast methodological differences between both rating approaches strengthens the validity of our findings. At the same time, the inconsistencies we observe in our results on self-selection effects emphasize the need for robustness checks to draw valid conclusions.

Ultimately, designing effective policies and incentives to promote corporate climate action requires a profound understanding of the psychological dynamics of influential decision-makers, specifically top executives. Our results highlight that these dynamics are complex, context-dependent, and require further discussion. Notably, CEO CC-related experiences do not necessarily translate into more climate-friendly policies – and they may even backfire. Hence, further research is needed to investigate factors that moderate the behavioral impact of climate-related experiences on climate action, specifically in an organizational context. While early-life experiences of CEO candidates may inform executive hiring, it is important to acknowledge that the direction of the effect may depend on prior convictions and context, such as current political developments or even geopolitical aspects, which have yet to be fully understood as determinants of climate policies.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2):179–211.

Ajzen, I. and Fishbein, M. (1973). Attitudinal and normative variables as predictors of specific behavior. *Journal of personality and Social Psychology*, 27(1):41–57.

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., and Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter? *Global environmental change*, 23(1):81–91.

Albuquerque, R., Koskinen, Y., and Zhang, C. (2019). Corporate social responsibility and firm risk: Theory and empirical evidence. *Management Science*, 65(10):4451–4469.

Allgood, S. and Farrell, K. A. (2003). The match between ceo and firm. *The Journal of Business*, 76(2):317–341.

Allgood, S., Farrell, K. A., and Kamal, R. (2012). Do boards know when they hire a CEO that is a good match? Evidence from initial compensation. *Journal of Corporate Finance*, 18(5):1051–1064.

Anderson, J. and Bausch, C. (2006). Climate change and natural disasters: Scientific evidence of a possible relation between recent natural disasters and climate change. *Policy department economic and scientific policy*, 2(2).

Bamber, L. S., Jiang, J., and Wang, I. Y. (2010). What's my style? The influence of top managers on voluntary corporate financial disclosure. *The Accounting Review*, 85(4):1131–1162.

Bazaz, A., Bertoldi, P., Buckeridge, M., Cartwright, A., de Coninck, H., Engelbrecht, F., Jacob, D., Hourcade, J.-C., Klaus, I., de Kleijne, K., et al. (2018). Summary for urban policymakers: What the IPCC Special Report on global warming of 1.5° C means for cities. Technical report.

Berg, F., Kölbel, J. F., and Rigobon, R. (2022). Aggregate confusion: The divergence of esg rating. *Review of Finance*. Online available at `https://doi.org/10.1093/rof/rfac033`.

Bernile, G., Bhagwat, V., and Rau, P. R. (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and ceo behavior. *The Journal of Finance*, 72(1):167–206.

Bertrand, M. and Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics*, 118(4):1169–1208.

Bromiley, P. and Rau, D. (2016). Social, behavioral, and cognitive influences on upper echelons during strategy process: A literature review. *Journal of Management*, 42(1):174–202.

Brügger, A. (2013). *Fear appeals and localising climate change: Neither is a panacea to motivate action on climate change: A social psychological perspective*. PhD thesis, University of Exeter.

Chatterji, A. K., Durand, R., Levine, D. I., and Touboul, S. (2016). Do ratings of firms converge? Implications for managers, investors and strategy researchers. *Strategic Management Journal*, 37(8):1597–1614.

Chatterji, A. K., Levine, D. I., and Toffel, M. W. (2009). How well do social ratings actually measure corporate social responsibility? *Journal of Economics & Management Strategy*, 18(1):125–169.

Chen, Y., Fan, Q., Yang, X., and Zolotoy, L. (2021). Ceo early-life disaster experience and stock price crash risk. *Journal of Corporate Finance*, 68:101928.

Chin, M., Hambrick, D. C., and Treviño, L. K. (2013). Political ideologies of ceos: The influence of executives' values on corporate social responsibility. *Administrative Science Quarterly*, 58(2):197–232.

Choi, D., Gao, Z., and Jiang, W. (2020). Attention to global warming. *The Review of Financial Studies*, 33(3):1112–1145.

Choi, D., Shin, H., and Kim, K. (2023). Ceo's childhood experience of natural disaster and csr activities. *Journal of business ethics*, pages 1–26.

Cohn, A., Fehr, E., and Maréchal, M. A. (2014). Business culture and dishonesty in the banking industry. *Nature*, 516(7529):86–89.

Dorfleitner, G., Halbritter, G., and Nguyen, M. (2015). Measuring the level and risk of corporate responsibility–An empirical comparison of different ESG rating approaches. *Journal of Asset Management*, 16(7):450–466.

Egan, P. J. and Mullin, M. (2012). Turning personal experience into political attitudes: The effect of local weather on americans' perceptions about global warming. *The Journal of Politics*, 74(3):796–809.

Ellingsen, T., Johannesson, M., Mollerstrom, J., and Munkhammar, S. (2012). Social framing effects: Preferences or beliefs? *Games and Economic Behavior*, 76(1):117–130.

European Environment Agency (2016). Sectoral greenhouse gas emissions by IPCC sector. `https://www.eea.europa.eu/data-and-maps/daviz/change-of-co2-eq-emissions-2#tab-dashboard-01`. Accessed 2023-08-05.

Fazio, R. H. and Zanna, M. P. (1978). Attitudinal qualities relating to the strength of the attitude-behavior relationship. *Journal of Experimental Social Psychology*, 14(4):398–408.

Fazio, R. H. and Zanna, M. P. (1981). Direct experience and attitude-behavior consistency. In *Advances in experimental social psychology*, volume 14, pages 161–202. Elsevier.

Gibbons, R. and Murphy, K. J. (1992). Optimal incentive contracts in the presence of career concerns: Theory and evidence. *Journal of Political Economy*, 100(3):468–505.

Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., Corral, V., Güntherf, H., Hanyu, K., Hine, D., et al. (2009). Temporal pessimism and spatial optimism in environmental assessments: An 18-nation study. *Journal of Environmental Psychology*, 29(1):1–12.

Graham, J. R., Li, S., and Qiu, J. (2012). Managerial attributes and executive compensation. *The Review of Financial Studies*, 25(1):144–186.

Griffin, P. and Heede, C. (2017). The carbon majors database. *CDP carbon majors report 2017*, 14.

Guenzel, M. and Malmendier, U. (2020). Behavioral corporate finance: The life cycle of a ceo career. Working Paper 27635, National Bureau of Economic Research.

Hambrick, D. C. (2007). Upper Echelons Theory: An Update. *Academy of Management Review*, 32(2):334–343.

Hambrick, D. C. and Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, 9(2):193–206.

Hao, J., Zhang, X., Cui, P., Li, L., Wang, Y., Zhang, G., and Li, C. (2023). Impacts of climate change on snow avalanche activity along a transportation corridor in the tianshan mountains. *International Journal of Disaster Risk Science*, pages 1–13.

Hart, P. S. and Nisbet, E. C. (2012). Boomerang effects in science communication: How motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Communication research*, 39(6):701–723.

Hegde, S. P. and Mishra, D. R. (2019). Married CEOs and corporate social responsibility. *Journal of Corporate Finance*, 58:226–246.

Huang, S. K. (2013). The impact of ceo characteristics on corporate sustainable development. *Corporate Social Responsibility and Environmental Management*, 20(4):234–244.

Joireman, J., Truelove, H. B., and Duell, B. (2010). Effect of outdoor temperature, heat primes and anchoring on belief in global warming. *Journal of Environmental Psychology*, 30(4):358–367.

Jovanovic, B. (1979). Job matching and the theory of turnover. *Journal of Political Economy*, 87(5):972–990.

Kahneman, D. and Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and biases: The psychology of intuitive judgment*, 49:81.

Kahneman, D. and Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, 3(3):430–454.

Kai, L. and Prabhala, N. R. (2007). Self-selection models in corporate finance. In *Handbook of Empirical Corporate Finance*, pages 37–86. Elsevier.

Keller, E., Marsh, J. E., Richardson, B. H., and Ball, L. J. (2022). A systematic review of the psychological distance of climate change: Towards the development of an evidence-based construct. *Journal of Environmental Psychology*, 81:101822.

Kinder, P. D. and Domini, A. L. (1997). Social screening: Paradigms old and new. *The Journal of Investing*, 6(4):12–19.

Kirilenko, A. P., Molodtsova, T., and Stepchenkova, S. O. (2015). People as sensors: Mass media and local temperature influence climate change discussion on Twitter. *Global Environmental Change*, 30:92–100.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Kolb, D. A., Boyatzis, R. E., Mainemelis, C., et al. (2001). Experiential learning theory: Previous research and new directions. *Perspectives on thinking, learning, and cognitive styles*, 1(8):227–247.

Kollmuss, A. and Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental education research*, 8(3):239–260.

Lai, S., Li, Z., and Yang, Y. G. (2020). East, west, home's best: Do local ceos behave less myopically? *The Accounting Review*, 95(2):227–255.

Lee, H., Romero (eds.), J., et al. (2023). limate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Technical report.

Leiserowitz, A. A. (2005). American risk perceptions: Is climate change dangerous? *Risk Analysis: An International Journal*, 25(6):1433–1442.

Lewis, B. W., Walls, J. L., and Dowell, G. W. (2014). Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal*, 35(5):712–722.

Liberman, N., Trope, Y., Stephan, E., et al. (2007). Psychological distance. *Social psychology: Handbook of basic principles*, 2:353–383.

Liberman, V., Samuels, S. M., and Ross, L. (2004). The name of the game: Predictive power of reputations versus situational labels in determining prisoner's dilemma game moves. *Personality and Social Psychology Bulletin*, 30(9):1175–1185.

Liu, Z., Deng, Z., Davis, S., and Ciais, P. (2023). Monitoring global carbon emissions in 2022. *Nature Reviews Earth & Environment*, 4(4):205–206.

Lowe, T., Brown, K., Dessai, S., de França Doria, M., Haynes, K., and Vincent, K. (2006). Does tomorrow ever come? Disaster narrative and public perceptions of climate change. *Public Understanding of Science*, 15(4):435–457.

Malmendier, U., Tate, G., and Yan, J. (2011). Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. *The Journal of finance*, 66(5):1687–1733.

Mattingly, J. E. and Berman, S. L. (2006). Measurement of corporate social action: Discovering taxonomy in the kinder lydenburg domini ratings data. *Business & Society*, 45(1):20–46.

McDonald, R. I., Chai, H. Y., and Newell, B. R. (2015). Personal experience and the 'psychological distance'of climate change: An integrative review. *Journal of environmental psychology*, 44:109–118.

Miller, D. (1991). Stale in the saddle: CEO tenure and the match between organization and environment. *Management Science*, 37(1):34–52.

Nelson, K. (1993). The psychological and social origins of autobiographical memory. *Psychological Science*, 4(1):7–14.

Oh, W.-Y., Chang, Y. K., and Cheng, Z. (2016). When ceo career horizon problems matter for corporate social responsibility: The moderating roles of industry-level discretion and blockholder ownership. *Journal of Business Ethics*, 133(2):279–291.

O'Sullivan, D., Zolotoy, L., and Fan, Q. (2021). Ceo early-life disaster experience and corporate social performance. *Strategic Management Journal*, 42(11):2137–2161.

Purohit, J. and Rout, H. S. (2023). Impact of climate change on human health concerning climate-induced natural disaster: evidence from an eastern indian state. *Climatic Change*, 176(8):109.

Raschky, P. A. (2008). Institutions and the losses from natural disasters. *Natural Hazards and Earth System Sciences*, 8(4):627–634.

Reuters (2020). Not personal enough: Why climate change is not yet a top priority. https://www.reuters.com/article/us-climatechange-security-politics-idUSKBN26T028. Accessed 2021-12-27.

Rudman, L. A., McLean, M. C., and Bunzl, M. (2013). When truth is personally inconvenient, attitudes change: the impact of extreme weather on implicit support for green politicians and explicit climate-change beliefs. *Psychological Science*, 24(11):2290–2296.

Sheeran, P. and Webb, T. L. (2016). The intention–behavior gap. *Social and personality psychology compass*, 10(9):503–518.

Sisco, M. R., Bosetti, V., and Weber, E. U. (2017). When do extreme weather events generate attention to climate change? *Climatic Change*, 143(1-2):227–241.

Slawinski, N., Pinkse, J., Busch, T., and Banerjee, S. B. (2017). The role of short-termism and uncertainty avoidance in organizational inaction on climate change: A multi-level framework. *Business & Society*, 56(2):253–282.

Spence, A., Poortinga, W., and Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, 32(6):957–972.

Teske, S., Nagrath, K., and Niklas, S. (2022a). Classification systems for setting net-zero targets for industries. In *Achieving the Paris Climate Agreement Goals: Part 2: Science-based Target Setting for the Finance industry—Net-Zero Sectoral 1.5° C Pathways for Real Economy Sectors*, pages 61–77. Springer.

Teske, S., Niklas, S., Talwar, S., and Atherton, A. (2022b). 1.5 c pathways for the global industry classification (gics) sectors chemicals, aluminium, and steel. *SN Applied Sciences*, 4(4):125.

Thomson Reuters Eikon (2018). Thomson reuters esg scores. https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/esg-scores-methodology.pdf. Accessed 2019-03-03.

Torregrosa, A., O'Brien, T. A., and Faloona, I. C. (2014). Coastal fog, climate change, and the environment. *Eos, Transactions American Geophysical Union*, 95(50):473–474.

Tversky, A. and Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157):1124–1131.

United Nations Human Rights – Office of the High Commissioner (2018). Joint statement of the United Nations Special Procedures Mandate Holders on the occasion of the 24th Conference of the Parties to the UNFCCC. https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=23982LangID=E. Accessed 2020-11-23.

Van Aalst, M. K. (2006). The impacts of climate change on the risk of natural disasters. *Disasters*, 30(1):5–18.

Waddock, S. A. and Graves, S. B. (1997). The corporate social performance–financial performance link. *Strategic management journal*, 18(4):303–319.

Wales, W. J., Patel, P. C., and Lumpkin, G. T. (2013). In pursuit of greatness: CEO narcissism, entrepreneurial orientation, and firm performance variance. *Journal of Management Studies*, 50(6):1041–1069.

Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., and Flora, J. (2018). Place, proximity, and perceived harm: extreme weather events and views about climate change. *Climatic Change*, 149(3):349–365.

Zaval, L., Keenan, E. A., Johnson, E. J., and Weber, E. U. (2014). How warm days increase belief in global warming. *Nature Climate Change*, 4(2):143–147.

A Paper appendix

A.1 Indicators for CC-related hazards and high-emitting ind.

Table A1: Indicators for CC-related hazards and high-emitting industries

Hazard Type	CC-Related	GICS Industry Groups	High-Emitting
Avalanche	1	Automobiles & Components	1
Coastal	0	Banks	0
Drought	1	Capital Goods	1
Earthquake	0	Commercial & Profess. Services	1
Flood	1	Consumer Durables & Apparel	1
Fog	1	Consumer Services	0
Hail	0	Diversified Financials	0
Heat	1	Energy	1
Hurricane/Trop. Storm	1	Food & Staples Retailing	0
Landslide	0	Food, Beverage & Tobacco	1
Lightning	1	Health Care Equipm. & Services	0
Severe Storm	1	Household & Personal Products	0
Snow Storm	0	Insurance	0
Tornado	0	Materials	1
Tsunami/Seiche	1	Media & Entertainment	0
Volcano	0	Pharm., Biotech. & Life Sciences	0
Wildfire	1	Real Estate	1
Wind	0	Retailing	0
Winter Weather	0	Semicond. & Semicond. Equipm.	0
		Software & Services	0
		Technology Hardware & Equipm.	1
		Telecomm. Services	0
		Transportation	1
		Utilities	1

Notes This table indicates, for each of the 19 hazard types from the SHELDUS^{TM} database, weather considered to be CC-related. It also indicates, for each of the 24 GICS Industry Groups, whether the group is classified as high-emitting with respect to greenhouse gas emissions. This is indicated by “1” as opposed to “0” in both cases.

A.2 KLD aggregate scores

To calculate KLD aggregate scores, we limit our focus to ESG criteria and exclude indicators for involvement in controversial industries. In total, we calculate "net scores" of 29 strengths and 30 concerns.[5]

Hence, we calculate the *KLD Aggregate Score* according to the following formula:

$$\text{KLD Aggregate Score}_{\text{i,t}} \equiv \sum^{S} strengths_{i,t} - \sum^{C} concerns_{i,t} \tag{6}$$

The *KLD Aggregate Score* is used in the Appendix for the validation of our sample in Table A2 and Table A4.

[5]The categories of 29 strengths and concerns only include a subset for which the data could be collected for the whole time period (1991-2015).

A.3 Time-fixed effects regression results

Table A2: Time-fixed Effects Regressions for KLD Aggregate Score

	KLD Aggregate Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	0.450**		0.617**	
	(0.206)		(0.275)	
CC-Related Exp.		0.120	−0.197	0.341
		(0.160)	(0.213)	(0.217)
High-Emitting Ind.				−0.086
				(0.244)
High-Emitting Ind.*CC-Related Exp.				−0.385
				(0.274)
Prior Score	0.494***	0.494***	0.496***	0.488***
	(0.022)	(0.022)	(0.022)	(0.022)
Ln(Total Assets)	−0.007	−0.009	−0.003	−0.023
	(0.029)	(0.029)	(0.029)	(0.029)
ROA	3.094***	3.168***	3.142***	3.112***
	(0.667)	(0.670)	(0.669)	(0.668)
Ln(Cash to Assets)	−0.002	−0.005	−0.001	−0.015
	(0.041)	(0.041)	(0.041)	(0.041)
CEO Age	0.011	0.002	0.010	0.007
	(0.011)	(0.011)	(0.011)	(0.011)
Observations	1,793	1,793	1,793	1,793
R^2	0.248	0.246	0.248	0.252
Adjusted R^2	0.235	0.233	0.235	0.239
F Statistic	96.693***	95.767***	82.994***	74.191***
Time-fixed Effects	Yes	Yes	Yes	Yes

Notes. This table reports time-fixed effects regression results for the relation between CC-related CEO early-life hazard experiences and the annual *KLD Aggregate Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability level, respectively. Standard errors are reported in parentheses.

Table A3: Time-fixed Effects Regressions for ASSET4 ESG Score

	ASSET4 ESG Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	5.501***		6.979***	
	(1.359)		(1.785)	
CC-Related Exp.		1.631	−1.651	2.047
		(0.991)	(1.294)	(1.363)
High-Emitting Ind.				2.224
				(1.869)
High-Emitting Ind.*CC-Related Exp.				−0.800
				(1.931)
Prior Score	0.668***	0.664***	0.668***	0.655***
	(0.020)	(0.020)	(0.020)	(0.021)
Ln(Total Assets)	1.154***	1.257***	1.143***	1.476***
	(0.222)	(0.222)	(0.222)	(0.241)
ROA	0.208***	0.214***	0.211***	0.223***
	(0.060)	(0.060)	(0.060)	(0.060)
Ln(Cash to Assets)	−0.154	−0.142	−0.138	−0.022
	(0.230)	(0.232)	(0.230)	(0.238)
CEO Age	−0.051	−0.095*	−0.059	−0.074
	(0.049)	(0.049)	(0.050)	(0.050)
Observations	1,029	1,029	1,029	1,029
R^2	0.638	0.633	0.639	0.635
Adjusted R^2	0.632	0.627	0.632	0.628
F Statistic	297.181***	290.979***	255.117***	219.623***
Time-fixed Effects	Yes	Yes	Yes	Yes

Notes. This table reports time-fixed effects regression results for the relation between CC-related CEO early-life hazard experiences and the annual *ASSET4 ESG Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability level, respectively. Standard errors are reported in parentheses.

A.4 OLS regression results

Table A4: OLS Regressions for Prior KLD Aggregate Score

	Prior KLD Aggregate Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	0.249		−0.592	
	(0.523)		(0.797)	
CC-Related Exp.		0.582	0.974	−0.011
		(0.457)	(0.698)	(0.641)
High-Emitting Ind.				−1.058
				(0.687)
High-Emitting Ind.*CC-Related Exp.				1.035
				(0.792)
Ln(Total Assets)	−0.070	−0.081	−0.083	−0.081
	(0.090)	(0.090)	(0.090)	(0.091)
ROA	2.628	2.541	2.642	2.313
	(1.615)	(1.605)	(1.612)	(1.613)
Ln(Cash to Assets)	0.167	0.175	0.176	0.160
	(0.132)	(0.132)	(0.132)	(0.134)
CEO Age	0.006	0.019	0.013	0.016
	(0.034)	(0.034)	(0.035)	(0.034)
Constant	0.555	−0.145	0.411	0.555
	(2.544)	(2.426)	(2.541)	(2.467)
Observations	270	270	270	270
R^2	0.026	0.031	0.033	0.040
Adjusted R^2	0.007	0.013	0.011	0.014
F Statistic	1.406	1.693	1.500	1.549

Notes. This table reports OLS regression results for the relation between CC-related CEO early-life hazard experiences and the *Prior KLD Aggregate Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability level, respectively. Standard errors are reported in parentheses.

Table A5: OLS Regressions for Prior ASSET4 ESG Score

	Prior ASSET4 ESG Score			
	(1)	(2)	(3)	(4)
Hazard Exp.	−5.655		−6.476	
	(4.924)		(6.328)	
CC-Related Exp.		−1.932	0.926	4.685
		(3.485)	(4.465)	(4.587)
High-Emitting Ind.				17.609***
				(6.209)
High-Emitting Ind.*CC-Related Exp.				−14.185**
				(6.564)
Ln(Total Assets)	5.193***	5.108***	5.206***	5.652***
	(0.740)	(0.739)	(0.745)	(0.754)
ROA	0.528***	0.508**	0.527***	0.501**
	(0.199)	(0.199)	(0.200)	(0.195)
Ln(Cash to Assets)	0.553	0.574	0.549	0.940
	(0.798)	(0.800)	(0.801)	(0.805)
CEO Age	−0.209	−0.166	−0.204	−0.055
	(0.189)	(0.187)	(0.191)	(0.187)
Constant	−13.216	−17.728	−13.760	−39.803**
	(16.810)	(16.615)	(17.059)	(17.741)
Observations	180	180	180	180
R^2	0.249	0.245	0.249	0.285
Adjusted R^2	0.227	0.223	0.223	0.256
F Statistic	11.542***	11.275***	9.573***	9.794***

Notes. This table reports OLS regression results for the relation between CC-related CEO early-life hazard experiences and the *Prior ASSET4 ESG Score*, which is the dependent variable in Columns (1) through (4). In Columns (1) through (3) the baseline is a CEO who has neither experienced a CC-related fatality nor a conventional fatality in his birth county between ages 5 and 15. In Column (4) the baseline is a CEO who has not experienced a CC-related hazard and who is not listed as a CEO working for a company in a high-emitting GICS Industry Group in our sample. Additionally, firm controls *Ln(Total Assets)*, *ROA* and *Ln(Cash to Assets)*, as well as the CEO-specific control *CEO Age* are included in each of the four models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability level, respectively. Standard errors are reported in parentheses.

B Internet appendix

B.1 Descriptive statistics

Table B1: CEO Characteristics

CEO Characteristics	CC-Related Exp. (N_{KLD} = 205) (N_{AS4} = 207)		Hazard Exp. (N_{KLD} = 223) (N_{AS4} = 226)		All Observations (N_{KLD} = 276) (N_{AS4} = 244)	
	Mean	SD	Mean	SD	Mean	SD
KLD Sample						
CEO Age	53.34	4.97	53.54	5.04	55.11	5.95
CEO Tenure	7.33	3.94	7.38	3.96	6.91	3.91
CEO Fat. (p10T)	9.90	31.10	9.43	29.89	7.62	27.11
CC-Related Exp.	1.00	0.00	0.92	0.27	0.74	0.44
Hazard Exp.	1.00	0.00	1.00	0.00	0.81	0.39
ASSET4 Sample						
CEO Age	54.71	5.40	54.67	6.10	55.27	6.82
CEO Tenure	6.26	2.42	6.19	2.45	6.11	2.47
CEO Fat. (p10T)	10.47	33.17	10.90	35.20	10.09	33.99
CC-Related Exp.	1.00	0.00	0.92	0.28	0.85	0.36
Hazard Exp.	1.00	0.00	1.00	0.00	0.93	0.26

Notes. This table reports summary statistics for relevant CEO characteristics. The first two columns depict the statistics for CEOs who have experienced at least one CC-related fatality in their birth county. The third and fourth columns show the statistics for the slightly larger group of CEOs who have experienced at least one fatality in their birth county, irrespective of the fatalities' climate change relatedness. The last two columns depict summary statistics for all observations. *CEO Age* Age is the age of the firm's CEO as of the fiscal year end when a CEO starts working at a firm. *CEO Tenure* measures the CEO's tenure years at a firm. *CEO Fat. (p10T)* is the total number of fatalities that occurred per 10T inhabitants in the CEO's birth county between their 5th and 15th years of life. *CC-Related Exp.* is an indicator variable equaling "1" (as opposed to "0") if at least one CC-related fatality occurred in the CEO's birth county during the time in question. *Hazard Exp.* is an indicator variable equaling "1" (as opposed to "0") if at least one fatality occurred in the CEO's birth county during the time in question, irrespective of the fatality's climate change relatedness.

Table B2: (Time-Varying) Firm Characteristics

Firm Characteristics	CC-Related Exp. (N_{KLD} = 1442) (N_{AS4} = 1192)		Hazard Exp. (N_{KLD} = 1577) (N_{AS4} = 1282)		All Observations (N_{KLD} = 1824) (N_{AS4} = 1366)	
	Mean	SD	Mean	SD	Mean	SD
KLD Sample						
KLD Aggregate Score	0.18	3.18	0.14	3.19	−0.06	3.14
KLD Climate Score	0.33	0.61	0.33	0.62	0.29	0.60
ROA	0.05	0.07	0.05	0.08	0.05	0.08
Ln(Total Assets)	18.68	1.98	18.60	2.01	18.61	1.96
Ln(Cash to Assets)	−3.25	1.38	−3.24	1.38	−3.24	1.38
High-Emitting Ind.	0.50	0.50	0.50	0.50	0.51	0.50
High-Emitting Ind.*CC-Related Exp.	0.50	0.50	0.46	0.50	0.40	0.49
ASSET4 Sample						
ESG Score	59.69	16.43	59.95	16.11	59.44	16.12
Emissions Score	59.81	27.59	60.40	27.27	59.16	27.63
ROA	5.05	5.67	5.00	5.64	4.96	5.54
Ln(Total Assets)	16.62	1.60	16.64	1.62	16.59	1.59
Ln(Cash to Assets)	−3.25	1.41	−3.28	1.40	−3.29	1.40
High-Emitting Ind.	0.46	0.50	0.47	0.50	0.47	0.50
High-Emitting Ind.*CC-Related Exp.	0.46	0.50	0.43	0.49	0.40	0.49

Notes. This table reports summary statistics for relevant firm-year observations in each fiscal year. The first two columns depict the statistics for companies with CEOs who have experienced at least one CC-related fatality in their birth county. The third and fourth columns show statistics for the slightly larger group of companies with CEOs who have experienced at least one fatality in their birth county, irrespective of the fatalities' climate change relatedness. The last two columns depict summary statistics for all observations. The *KLD Score* is calculated as the "net score" of 29 strengths and 30 concerns from the KLD categories, and the *KLD Climate Score* comprises the Carbon Emission and Water Stress strengths (concerns) from the KLD categories. The *ESG Score* and the *Emissions Score* are obtained from Datastream. *Ln(Total Assets ($M))* is defined as the natural log of total book assets in million US-dollars. *ROA* is defined as net income divided by total assets, and *Ln(Cash to Assets)* is the natural log of the ratio of cash to total assets. *High-Emitting Ind.* refers to the indicator variable as defined in the right panel of Table A1. *High-Emitting Ind.*CC-Related Exp.* refers to the interaction term between the indicator variables *High-Emitting Ind.* and *CC-Related Exp.*, the definition and summary statistics of which are outlined in Table B1.

B.2 Correlation matrices

Table B3: Correlation Matrix CEO Characteristics

	CEO Fat. (p10T)	CC-Rel. Exp.	Haz. Exp.	CEO Age	CEO Tenure
ASSET4 Sample					
CC-Rel. Exp.	0.062				
Haz. Exp.	0.084	0.733 ***			
CEO Age	-0.007	-0.405 ***	-0.311 ***		
CEO Tenure	-0.037	0.051	0.114 *	-0.200 ***	
Female	-0.028	0.057	0.016	-0.096	-0.012
KLD Sample					
CC-Rel.Exp.	0.131 **				
Haz. Exp.	0.137 **	0.953 ***			
CEO Age	-0.067	-0.519 ***	-0.540 ***		
CEO Tenure	-0.022	0.235 ***	0.248 ***	-0.427 ***	
Female	-0.004	0.103 *	0.108 *	-0.013	-0.017

Notes. This table reports the correlation matrix for CEO characteristics. The linear correlation coefficients are calculated after Pearson. A Student's t-test is applied for values of the Pearson Correlation Coefficients by taking the sample size of each pairwise computation. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively.

Table B4: Correlation Matrix of Firm Characteristics

	A4 ESG Score	A4 Emiss. Score	Ln(Total Ass.)	ROA	Ln(Cash to Ass.)	High-Em. Ind.
A4 Emiss. Score	0.779 ***					
Ln(Total Ass.)	0.384 ***	0.362 ***				
ROA	0.147 ***	0.125 ***	-0.150 ***			
Ln(Cash to Ass.)	-0.106 ***	-0.052 *	-0.372 ***	0.181 ***		
High-Em. Ind.	0.047 *	0.042	-0.272 ***	-0.022	-0.099 ***	
High-Em. Ind.*CC-Exp.	0.027	0.023	-0.211 ***	-0.022	-0.084 ***	0.872 ***

	KLD Agg. Score	KLD Clim. Score	Ln(Total Ass.)	ROA	Ln(Cash to Ass.)	High-Em. Ind.
KLD Clim. Score	0.533 ***					
Ln(Total Ass.)	-0.037	0.112 ***				
ROA	0.098 ***	0.122 ***	0.003			
Ln(Cash to Ass.)	0.041 *	0.031	-0.227 ***	0.160 ***		
High-Em. Ind.	-0.108 ***	-0.040 *	-0.060 ***	-0.054 **	-0.059 **	
High-Em. Ind.*CC-Exp.	-0.010	0.026	-0.064 ***	0.020	-0.037	0.799 ***

Notes. This table reports the correlation matrix for firm-specific variables used in our regression analyses. The linear correlation coefficients are calculated after Pearson. A Student's t-test is applied for values of the Pearson Correlation Coefficients by taking the sample size of each pairwise computation. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively.

Appendix B. Second research paper

The Ratings Game: What’s beneath ESG Scores? An Empirical Study of the Divergence and Underlying Data of ESG Scores

The Ratings Game:

What's beneath ESG Scores?

An Empirical Study of the Divergence

and Underlying Data of ESG Scores

Simone. A. Wagner

PhD student

Chair of Management and Sustainability

University of Hamburg

Rentzelstr. 7, 20146 Germany

simone.wagner@uni-hamburg.de

Tel. +49 1704173514

The Ratings Game:

What's beneath ESG Scores?

An Empirical Study of the Divergence

and Underlying Data of ESG Scores

Abstract

This study empirically compares ESG scores and investigates their underlying raw data. Based on an analysis of prominent ESG rating agencies (RAs); MSCI ESG Research Inc., Sustainalytics, Bloomberg, and Refinitiv Inc., I investigate the effects of changes in the underlying raw data to changes in ESG scores. While previous literature has shown that ESG scores diverge, this paper analyzes how dynamic changes to firm-specific underlying raw data are reflected in ESG scores. My findings show that RAs disagree how to incorporate of underlying raw data into their ESG scores, and that these scores react differently to changes in underlying data.

Keywords: ESG scores, ESG ratings, underlying data, impact, sustainable finance

1 Introduction

Managing sustainability risks and opportunities is becoming more important to the strategic management of a firm (e.g., Hart, 1995; Siegel and Vitaliano, 2007). Therefore, investors take these risk factors into account when making portfolio-allocation decisions. Allison Herren Lee, the Acting Chair of the U.S. Securities and Exchange Commission, emphasizes this shift in focus and the increasing use of climate aspects and further ESG risks in investors' decision-making processes (Lee, 2021). This huge market potential attracts various interested parties, such as companies that provide sustainability measurements, e.g., ESG scores. Sustainability rating agencies (RAs) provide this information by assessing a firm's corporate social performance (CSP) and/or its means to manage sustainability risks and/or sustainability disclosure (Avetisyan and Hockerts, 2017; Directorate-General for Financial Stability, Financial Services and Capital Markets Union (European Commission), and Environmental Resources Management Ltd., 2020).[1]

The multidimensional nature of social and environmental performance results in varying definitions and conceptual differences in the literature. Firms' diverse reporting standards and measurement methods lead to discrepancies in ESG scores. Researchers identify differences in scoring processes, such as measurement scope and weighting among RAs, raising concerns about transparency (e.g., Berg, Kölbel and Rigobon, 2022). Ambiguity in information hampers managers' ability to effectively prioritize sustainability investments (Avetisyan and Ferrary, 2013; Berg, Kölbel and Rigobon, 2022; Chatterji, Durand et al., 2016; Delmas et al., 2013; Haerens, 2019).

In sum, RAs employ different attributes with varied weights and measurement methods to calculate their scores, making their ratings divergent. Scholars question the reliability and validity of ESG information, raising concerns about whether these scores accurately reflect firms' sustainability behavior. The link between real factors, i.e. underlying

[1]Henceforth, this study only focuses on ESG scores as sustainability measurements. In literature, ESG scores are also referred to as corporate social responsibility (CSR) ratings. Following this, I use the term RA for providers of such scores.

raw data, and ESG scores is crucial; if it diminishes, the usefulness of these scores is compromised. Taking these observations into account, Busch, Bauer and Orlitzky (2016: p. 316) ask whether ESG information can be an aid to sustainable development if information does "not reliably and validly reflect organizational reality – that is, we do not measure what we want to measure". Other scholars pose similar questions regarding the accuracy of RA measurements and how well they reflect firms' sustainability behavior (e.g., Chatterji, Durand et al., 2016). Hence, gauges to measure ESG factors that have an effect on sustainability have to be identified.

In this vein, Busch, Bauer and Orlitzky (2016) emphasize the importance of identifying the correct ESG criteria, which translate to the desired type of business activity or information. Thus, literature suggests using underlying raw sustainability measures so that dynamic changes can be studied (e.g., Barnett, 2007; Peloza, 2009). In this context, dynamic changes in underlying raw data (such as changes in annual CO_2 emissions) and their reflection in ESG scores poses an as yet unstudied research phenomenon. Hence, this study focuses on discussion about the reliability and comparability of ESG ratings by asking the following research question: Do ESG scores reflect actual sustainability performance improvements as reported by underlying raw data?

This paper contributes to the understanding of the relationship between underlying raw data and ESG scores. Instead of focusing on methodological differences, I investigate whether ESG scores reflect firms' behavior in terms of underlying raw data, e.g., CO_2 in tons. To do so, I collected huge data sets from 2007 to 2018 from four well-known RAs: Morgan Stanley Capital International (MSCI) ESG Research Inc., Sustainalytics (SUS), Bloomberg (BL), and Refinitiv (REF) Inc., formerly known as Thomson Reuters, which reflects a score for ESG reporting rather than for than ESG performance. I performed my first set of analyses to corroborate my data with data previously used in literature. Therefore, I compare the ESG score results of the four aforementioned RAs in a detailed investigation of similarity and divergence. My findings are in line with previous literature on divergence of ESG scores (e.g., Avetisyan and Hockerts, 2017; Berg, Kölbel and Rigobon, 2022; Dorfleitner et al., 2015; Windolph, 2011), which report tremendous differences between aggregated ESG scores and the single pillar scores of environmental, social or governance issues. This corroborates that my samples of ESG scores across MSCI, SUS, BL, and REF are representative. In the second and main part of my analyses, the underlying raw data is intensively investigated. For these analyses, I identify the most commonly used raw data points in ESG measurements (key indicators (KI)), e.g., carbon emissions in tons. I identify 14 of these KIs across all four RAs. After I collect them from Refinitivs' ASSET4 database for these indicators, I study how well ESG scores and their sub-pillars E, S, and G, represent the underlying raw data of the identified KIs. The results demonstrate that there is a disagreement about the underlying data in terms of their relationship to ESG scores. ESG scores from different RAs react differently in terms of amplitude and significance of changes in underlying raw data.

This study makes significant contributions to the academic literature and provides valuable insights for practitioners. First, before conducting any analyses, I confirm with the baseline hypothesis (H1) that ESG scores from different RAs differ for a single firm. Thus, this study is the first to investigate the sensitivity of ESG scores to changes in underlying raw data. My main results of testing hypothesis (H2) show that fundamental differences occur in ESG scores for each of the different RAs when the underlying raw data is changed, which is problematic for all users of this data. In this context, my research finds evidence that there is no consistency to how ESG scores react to changes in underlying raw data that are directly reported by the firms, such as carbon emissions in tons. This evidence is robust over sub-samples of region and time. Disentangling the time dimension into single years from 2007 to 2018 reveals that the divergence for coefficients of underlying raw data variables of the four RAs is more present in recent years, i.e., after 2010. With this insight, I contribute to a growing strand of literature in management that focuses on understanding ESG scores. Second, my results contribute to the literature about the transparency and understanding of ESG scores as a measurement tool of sustainability. Prior literature (e.g., Berg, Kölbel and Rigobon, 2022) already added a great deal of transparency to important similarities and differences between ESG scores. This study, with its huge data set from four big RAs, goes beyond previous studies and examines from an empirical point of view what is behind ESG scores. It becomes evident that the sensitivity of ESG scores, and their pillar scores, to changes in underlying raw data is not equal for each RA. This heterogeneous sensitivity is also consistent and not explainable solely by regional and time differences. Academics should be aware that their study results also depend on their choice of RA. Moreover, the choice of an RA shapes the investment-making decisions of investors. Within this context, my results amplify the need to investigate ESG scores in more depth to make an informed investment decision. Investors who seek investments that identify changes in KIs should focus on the underlying raw data of ESG scores to gauge their effect. RAs should move towards greater transparency in terms of the use of underlying raw data variables. Finally, regulators could harmonize ESG scores by setting more consistent rules for firms' ESG disclosures.

In what follows, I outline the literature on sustainable investing, as well as the derivation of ESG scores. After the development of two main sets of hypotheses, Section 3 describes the data and the sample, as well as my empirical strategy. SThe main findings are discussed in Section 4. Finally, Section 5 offers critical reflections, summarizes empirical results, and outlines future research directions.

2 Theoretical framework

2.1 Literature review

Research on Socially Responsible Investing (SRI) is fragmented. This fragmentation is in part due to the vast heterogeneity in operational definitions of SRI.

In this vein, the European Commission (2020) suggests alternative terms for SRI such as 'sustainable finance'. The European association European Sustainable Investment Forum (EuroSIF) defined these investment types as "a long-term oriented investment approach which integrates ESG factors in the research, analysis and selection process of securities within an investment portfolio. It combines fundamental analysis and engagement with an evaluation of ESG factors in order to better capture long-term returns for investors, and to benefit society by influencing the behavior of companies" (EuroSIF, 2018: p.12).

In the past decade, scholars and practitioners embraced sustainability through the E, S, and G pillars, using measurements from various sources (e.g., Hart and Ahuja, 1996; Jo and Harjoto, 2012; Waddock and Graves, 1997; Wagner, 2010). The shift from traditional to SRI investments continues to gain momentum, leading to a surge in RAs. These RAs, described as providing investor and company solicited rating services, corporate research, and compliance services akin to credit rating agencies, focus on ESG criteria (Avetisyan and Hockerts, 2017: p. 317). Avetisyan and Hockerts (ibid.: p. 317) describe the business of RAs as "investor-solicited and company-solicited rating services, corporate research, compliance and consulting services analogous to those provided by credit rating agencies - but with a focus on ESG criteria". Escrig-Olmedo et al. (2019: p. 1) report that RAs have become "a key reference" regarding the assessment of a corporation's sustainability. Avetisyan and Ferrary (2013: p. 125) see RA nowadays as "new Institutional Entrepreneurs" that offer corporate research, compliance, and consulting services in addition to rating services.

Investors, practitioners, and academics heavily rely on RA for ESG scores, which significantly impact asset prices and corporate and governmental policies. Despite their widespread use, there's limited systematic research on the ESG scores industry. Different RAs employ varying methods, leading to inconsistencies in scores. These differences stem from varying measurements (e.g., Avetisyan and Ferrary, 2013; Avetisyan and Hockerts, 2017; Widyawati, 2020), methodologies (e.g., Berg, Kölbel and Rigobon, 2022; Dorfleitner et al., 2015; Doyle, 2018; Windolph, 2011), and underlying raw data usage among RAs. For example, RAs may prioritize different indicators for social sustainability and employ diverse measurement scopes, resulting in divergent scores for the same attribute. This divergence creates non-transparency issues within and between firms, making it challenging to assess their ESG performance consistently. This lack of consistency is associated with validity and reliability concerns, highlighting the challenge of obtaining reliable non-financial sustainability information (e.g., Berg, Kölbel and Rigobon, 2022; Chatterji, Durand et al., 2016; Chatterji, Levine and Toffel, 2009; Christensen et al., 2022; Eltogby et al., 2019; Griffin and Mahon, 1997; Orlitzky, 2013; Rowley and Berman, 2000; Eccles, Lee and Stroehle, 2020).

As a consequence, researchers studying SRI encounter divergent findings and implications, even with consistent methods and firm samples, due to the significant influence of the chosen Responsible Agency (RA). Empirical studies exploring this topic range from using ESG scores in indices and mutual funds (see Chegut et al., 2011; Curran and Moran, 2007; Schröder, 2007; Statman, 2005) to investigating the relationship between corporate social performance and financial performance (e.g., Abbott and Monsen, 1979; Aupperle et al., 1985; Ostlund, 1977; Teoh et al., 1991; Ullmann, 1985).

Practitioners face a similar dilemma. The widespread use of ESG scores significantly impacts investment cycles, affecting management practices in firms and the behavior of financial market participants (Christensen et al., 2022; Slager et al., 2012). However, incorporating ESG results into asset prices poses challenges for investors. While investors' opinions can influence prices, divergent views on firms' ESG performances lead to fragmented investor preferences, making it challenging to affect asset pricing uniformly (Fama and French, 2007). Consequently, ESG scores, while capable of creating positive impacts, can also misguide investment decisions (Christensen et al., 2022). Furthermore, sustainable investing not only influences financial markets but also plays a role in shaping society as a whole (ibid.).

In light of this vast heterogeneity, and its importance for practitioners as well as researchers, the question arises of whether RAs are in fact meeting investors' demands. In addition, Busch, Bauer and Orlitzky (2016: p. 316) ask whether ESG data can contribute to sustainable development if data "do not reliably and validly reflect organizational reality – that is, we do not measure what we want to measure". Investors and scholars are looking for measurements that have an effect and contribute to sustainable development, respectively.

However, if the effect and the link to real factors vanish, users' expectations will not be met, and it could even lead to claims that the provided information is misleading. Therefore, it is also in the interest of RAs as well as the rated firms that results are transparent and trustworthy (Clementino and Perkins, 2020; Murè et al., 2021; Robinson et al., 2011; Scalet and Kelly, 2010).

Scholars have acknowledged the ambiguity in ESG data and have conducted empirical studies incorporating robustness checks like self-constructed sustainability assessments or using different RAs (e.g., Chatterji, Durand et al., 2016; Chatterji, Levine and Toffel, 2009). Authors, such as Berg, Kölbel and Rigobon (2022), have delved into the factors influencing ESG ratings across RAs. Additionally, literature on ESG assessments explores their role in understanding business models and CSR implementation in firms (e.g., Cho et al., 2012; Rajesh and Rajendran, 2020). Similar trends are observed among practitioners. Despite the increasing use of ESG scores, methodologies and scoring approaches remain underexplored and inadequately scrutinized. Researchers emphasize the need for enhanced data collection reliability, particularly concerning underlying raw data. Busch, Bauer and Orlitzky (2016) stress the importance of aligning specific ESG criteria with corresponding business activities or information. Consequently, there should be a focus on refining underlying sustainability measures and studying their dynamic effects (e.g., Barnett, 2007; Peloza, 2009).

2.2 Hypothesis development

Divergence. Previous studies highlight five key issues in ESG scores: (i) lack of transparency since RAs do not publicly disclose all information; (ii) low commensurability between ESG providers due to missing standardization [2]; (iii) trade-offs among criteria; (iv) lack of independence between ESG RA and rated firm; (v) neglect of stakeholders' preferences.[3]

[2]Further investigations by Berg, Fabisik and Sautner (2020) reveal that differences in ESG scores could even occur ex post because of the provider's 'rewriting' of ESG scores. This means the content of ESG data even depends upon the time of downloading.

[3]Notes: This enumeration is not complete. Depending on the research focus in literature, further shortcomings may be found (see for further information Chatterji and Levine, 2006; Christensen et al., 2022; Dorfleitner et al., 2015; Escrig-Olmedo et al., 2019; Saadaoui and Soobaroyen, 2018; Sandberg

The vast heterogeneity in ESG scores, as revealed by Berg, Kölbel and Rigobon (2022), is primarily driven by measurement divergences among RAs in assessing ESG attributes. Differences in the gauges used, the scope of underlying raw data, and weightings are not standardized and can change annually, making ESG data a social construct influenced by RAs' organizational characteristics. Additionally, Berg, Kölbel and Rigobon (ibid.) found that the weightings of each measurement is not standardized among the RAs. Likewise, the scope of the measurements and their weighting is presumed to change on an annual basis. Eccles and Stroehle (2018) point out that these kinds of differences stem from each RA's organizational characteristics (e.g., country of origin, founders, and first clients). Hence, ESG data is rather understood more as a social construct than as a fixed concept.

These insights form the basis for the formulated baseline hypotheses:

Hypothesis 1a (Divergence in aggregated ESG scores). *Aggregated ESG scores from different RAs diverge for a single firm.*

Hypothesis 1b (Divergence in E, S and G pillar scores). *E, S, and G pillar scores from different RA diverge for a single firm.*

Underlying raw data. As suggested in the literature on divergence (e.g., Berg, Kölbel and Rigobon, 2022; Christensen et al., 2022), underlying raw data can be seen as the common denominator of ESG scores. These underlying raw data points reflect firms' activities through different measurements. Berg, Kölbel and Rigobon (2022) see measurement divergence as problematic since ESG scores should be based on observations (e.g., reported by the firm). These objective observations provide the same basis for each ESG score. Within this context, no empirical study reflects upon the underlying raw data, which should be carefully considered as the foundation for ESG scores. Hence, investigating the effects of underlying raw data on ESG scores is of the highest interest.

Underlying raw data, originating directly from firms' unaltered reports, forms the basis for ESG measurement. These data points, like carbon emissions or child labor policies, are classified within the E, S, and G pillars.Environmental data often shows continuous changes,

et al., 2008; Scalet and Kelly, 2010; Windolph, 2011).

while social and governance variables are typically nominal or categorical. While nominal or categorical variables may be changed by one-time investments or actions, continuous measurements are obligated to measure repeated investments or actions, usually on a regular basis. Researchers acknowledged this observation by dividing non-financial measurements into outcome-based and process-based gauges (Busch and Hoffmann, 2011; Ginsberg, 1988; Wood, 1991). Busch and Hoffmann (2011) further describe how outcome-based variables focus on direct performance, e.g., total amount of use, and do not examine the reason for performance changes. Process-based measurements ignore performance in absolute terms, but target firms' internal efforts, e.g., categorization of the stage of an environmental management system. The collection of underlying raw data is challenging, since how firms report on their sustainability efforts varies greatly. However, due to emerging regulative standards in the European Union[4], for example data-collecting methods will becoming increasingly standardized. Hence, the reported data will become more prevalent and available in the coming years.

Hence, in order to analyze the effects of underlying raw data on ESG scores, the following main hypotheses are formulated:

Hypothesis 2a (Aggregated ESG scores on changes in underlying raw data). *Aggregated ESG scores from different RAs reflect changes in the same underlying raw data differently for a single firm.*

Hypothesis 2b (E, S, and G pillar scores on changes in underlying raw data). *E, S and G pillar scores from different RA reflect changes in the same underlying raw data differently for a single firm.*

[4]See the proposed Corporate Sustainability Reporting Directive by the European Commission (European Commission, 2021).

3 Data and sample description

3.1 Measures of aggregated and E, S, and G pillar scores

My sample for aggregated scores and for each pillar of ESG consists of annual ESG scores from four RAs: MSCI ESG scores from MSCI ESG Research, ESG scores from SUS, ESG disclosure data set from BL Sustainability, and REF's ESG data set obtained by Datastream and REF Eikon.[5] The overall ESG scores are often used in literature as proxies for a firm's sustainability performance. Scholars classify all four of the RAs that I used for data as among the most influential RAs (Boffo and Patalano, 2020; Eltogby et al., 2019). Moreover, the pillar scoring for each RA is used for particular environmental, social, and governance aspects. The time period of my sample ranges from 2007 to 2018 and has a delta of one year. In order to circumvent a possible survivorship bias, I do not exclude delisted firms during the time of observation.[6]

This panel data contained 174,189 observations before merging it with the second data set (*Measures of underlying raw data*). After the merge, the unique observations to firm-year combinations were limited to 116,994 observations. Scores from MSCI have already been transformed to a scale from 0-100 in the data set. Furthermore, I decided to reduce the sample to observations for which an ESG score exists from all four of the RAs, in order to compare all four RAs equally. This resulted in 7,708 unique firms over the time period of 2007 to 2018 remaining in the sample.

Table 1 provides details of all *measures of aggregated and ESG pillar scores* that I use.

[INSERT Table 1 HERE]

To gather a more in-depth understanding of different concepts in scoring, methodologies for four relevant RAs, which cover a substantial ESG market share, are examined: MSCI, SUS, BL, and REF. The scoring methods have evolved over ten years due to the growth

[5] Note that some literature suggests that BL and REF both provide an ESG reporting score that points out what type of information is disclosed by firms rather than materializing ESG risks and opportunities (SUS and MSCI).

[6] This procedure is acknowledged and has been applied by prior research (Auer and Schuhmacher, 2016).

and consolidation of providers and their strategies, often marked by mergers or acquisitions. (Escrig-Olmedo et al., 2019; Novethic Research, 2013; SustainAbility, 2020). While these methods are influenced by cultural, ideological, and differentiation factors, all assessment processes share common aspects: constructing scoring categories based on aggregate ESG levels, negative screening, and normalization or weighting of scores by industries. However, despite these commonalities, divergent methodologies exist among RAs, influenced by various cultural and strategic factors (Escrig-Olmedo et al., 2019; Saadaoui and Soobaroyen, 2018; Sandberg et al., 2008).

3.2 Measures of underlying raw data

In this paper, I define underlying raw data as the raw data for ESG scores. It is crucial that these data points are not assessed and preferably they are directly reported by the firm itself. Such gauges originally stem from annual reports, CSR or sustainability reports, websites, etc. Within the scope of this study, underlying raw data from REF's Eikon and Datastream is accessed. Data from the former ASSET4 can be found in both applications.

This panel data originally consisted of 215,507 observations. In sum, around 300 underlying raw data variables were included in the raw data set. Among them were underlying environmental raw data, e.g., CO_2 emissions, underlying social raw data, e.g., human rights, and underlying governance raw data, e.g., corporate governance. The final sample set here also consists of unique firm-year observations that were merged with the data set of *measures of aggregated and ESG pillar scores.* 7,708 unique firms over the time period of 2007 to 2018 remained in the sample.

[INSERT FIGURE 1 HERE]

In a next step, I select variables of interest for this study. A recent study on sustainability-related scores and data by the European Commission (2020) and a paper by Escrig-Olmedo et al. (2019) provided the orientation for the selection. The European Commission (2020) presents an overview of common environmental, social, and governance issues, which are summarized in Figure 1.

Thus, the final sample consists of 14 variables from ASSET4, presented in Table 2. Moreover, in the last column of the table, the respective dimension (E, S, or G) has been added along with a link to one or more of the issues that are identified as common issues by the European Commission (2020).

Further, I verified the underlying raw data. For this purpose, the data provided in the data set has been compared to data originally reported by the firms, e.g., in the respective sustainability reports and annual reports. This verification has been done for a sample of randomly selected firms for all years for which the data could still be retrieved from publicly available sources. The sample consists of underlying raw data for 25 firms for all variables in Table 2. In this vein, 163 observations are verified. The comparison to the underlying raw data set shows that all observations matched, except that three deviations of more than ten percent from the data provided in the data set were found. Altogether, the difference between the provided data and the manually sourced values is below one percent for all variables; therefore, it can be assumed that the data provided in the data set is equal to the actual data reported by firms. Thus, the underlying raw data set is used for further for the analyses.[7]

[INSERT TABLE 2 HERE]

4 Empirical results

4.1 Descriptive statistics

In this research, I distinguish between *measures of aggregated and ESG pillar scores* and *measures of underlying raw data.* Whereas ESG scores are assessed by each RA differently, underlying raw data is defined as the 'pure' reported data that has not been influentially effected by RAs.

Measures of aggregated and ESG pillar scores. Table 3 depicts the descriptive statistics of cross-sectional data with the data set of *measures of aggregated and ESG pillar scores* and

[7]The data for verification can be provided upon request.

measures of underlying raw data. [8] All scores are in a normal and predicted range between zero and 100. Thus, there is no need to winsorize the data. In addition, comparing the observation counts of the full samples (Table A1 in Appendix A Table 6) with the samples matched with the underlying raw data (Table 3) reveals that only a few observations have been dropped in the matching process. Furthermore, other characteristics for each sample distribution stayed on a relatively equal level before and after the matching process. Moreover, MSCI and SUS data show observations almost within the full scale range (from 2.5 to 100), while the scores of BL and REF never reach the full scores of 100. Comparisons between the RAs may indicate a variety of measurements in terms of characteristic attributes. The moments of distribution show that they differ from each other in Table 3.

Measures of underlying raw data. Table 4 summarizes the descriptive statistics of underlying raw data variables in my sample. No variable is not assessed or modified in any way, e.g., normalized or scaled. Therefore, the scales' range differs widely for each variable. All binary variables indicated with a (Y/N) are in the predicted range between 0 (if "No") and 1 (if "Yes"). Most binary variables in my sample reflect the implementation of a policy, i.e., Emission_pol, HR_pol, and HR_supply_pol. In addition to policy indications, other binary variables report firms' actions without a measurement, i.e., Renew_energy_use, CSR, CSR_report, and UNGC. Further variables are captured with continuous measurements, e.g., Energy_use in PJ. The number of observations for the 14 variables varies from 6,972 (for NOx) to 48,571 for binary variables, e.g., CSR. The mean values for each variable show a positive number. For all binary variables, this implies that more observations report an implementation of a policy or an action measured by the variables with "Yes".

[INSERT TABLE 3 HERE]

[8] Table A1 in Appendix A Table 6 shows the descriptive statistics of full samples.

4.2 Hypothesis 1 (baseline): ESG scores

To further investigate the distribution differences of the RAs, I graphically displayed them in histograms. Figure 2 shows the histograms for each ESG score and sub-score categorized by RA. Figure 2 corroborates the literature on the divergence of ESG scores and the descriptive statistics in Table 3. BL's overall score and sub-scores exhibit a right skew, with a skewness of 1.1. Among them, the governance score is the most centrally distributed. In addition to the skewness, BL's mean of 22.8 is the lowest compared to other RAs' means. Moreover, the kurtosis of BL's scores show a more leptokurtic distribution than the others RAs' scores. SUS' histograms are shaped with a similar but less strong skewness. MSCI scores are mostly concentrated in the range between 30 and 60, with a mean of 46.5 and a standard deviation of 22.8, whereas REF's results, with a mean of 50.3 and a standard deviation of 17.5, range between the patterns of MSCI and BL.

[INSERT TABLE 4 HERE]

Additionally, I investigated the ranks of the scores within each RA. The correlation table in Appendix B Table 7 displays the Spearman rank correlation. It points out that the ranks in the overall ESG scores are slightly positively correlated with their sub-scores' ranks within one RA. Moreover, it appears that within one RA the ranks in governance issues are less strongly correlated with the ranks of the overall score than the E and S pillar ranks. The comparison of the correlation coefficients between different RAs reveals that all four RAs' score ranks are positively correlated. Their correlation coefficients for the rank in overall ESG scores are on average greater than 0.5. MSCI's score ranks are the exception. MSCI's rank in the overall ESG score in comparison with another RA's overall ESG score ranks shows correlation coefficients varying between 0.39 and 0.52. Particularly, governance score ranks for different RAs are less related to each other.

[INSERT FIGURE 2 HERE]

Further corroboration for a divergence of ESG scores from different RAs is shown in the results of the Wilcoxon rank-sum[9] tests.[10]

[INSERT TABLE 5 HERE]

According to the results shown in Table 5, p-values are for all overall ESG score comparisons between the RAs are significant at a one percent level. Hence, the null hypothesis of the Wilcoxon test can be rejected, which leads to the conclusion that the overall ESG scores are not equal[11].

Hence, summarizing all prior tests and diagrams, it follows that both Hypotheses 1a and 1b can be corroborated. Thus, aggregated scores and each pillar of ESG from different RAs diverge for a single firm in this data set.

4.3 Hypothesis 2 (main): Underlying raw Data

After showing that my sample is representative of ESG data used by academics and practitioners with the divergence of aggregated scores and each pillar of ESG, I further investigate their relationship to the underlying raw data. Does the ESG score from one RA react differently to a change in the underlying raw data than the ESG score from another RA? Which RA's score reacts the most sensitively to a change in underlying raw data? In the following, a fixed-effects model is described and analyzed:

$$\mathrm{Score}_{\mathrm{i,t}} \sim \text{Underlying raw data variable}_{\mathrm{i,t}} + \theta_{\mathrm{t}} + \epsilon_{\mathrm{i,t}}, \tag{1}$$

[9]Note: Since the samples do not meet the necessary requirements, i.e., normal distribution and same standard distributions for two sample tests, to perform parametric tests, e.g., (paired) t-tests, I abstained from using (paired) t-tests or Welch's t-tests. Moreover, the t-tests for testing equal means cannot answer the research question on the divergence of ESG scores. Statistics supporting the null hypothesis do not prove equal scores on an individual (firm) level. The reverse can also be true: failing the null hypothesis does not prove that the rank of the individual (firm) can be equal across all RAs. Statistics can be provided upon request.

[10]Further tests with sample splits, e.g., by region, have been performed and reveal the same picture. Statistics can be provided upon request.

[11]The Wilcoxon signed-rank test for matched-pairs has also been performed for the sub-scores of the three pillars E, S, and G, the results of which indicate the same conclusion. Statistics can be provided upon request.

Where $Score_{i,t}$ represents firm i's ESG or pillar (E, S, or G) score in a year t. *Underlying raw data variable*$_{i,t}$ as the independent variable of interest changes from model to model. θ_{t} captures time-fixed effects and $\epsilon_{\mathrm{i,t}}$ is the error term.

Table 6 presents elasticities and semi-elasticities of underlying raw data on ESG Scores. Elasticities are calculated for all continuous variables and semi-elasticities for binary underlying raw data, which are indicated with an "i." as prefix. Table 6 displays the results of a fixed-effects panel estimation model with cluster-robust standard-errors on firm-level. Horizontally, the four RAs are analyzed. For each RA, two columns are shown, one for the corresponding ESG score and one for its pillar score. On the vertical axis, underlying raw data is categorized into three pillars: E, S, and G. Below the coefficients the table displays the number of observations used for each estimation in parentheses.

The coefficients reveal that one indicator of underlying raw data differently effects RAs' ESG and respective pillar scores. For example, the indicator *Women* has an effect on the ESG and social pillar scores for BL, REF, and SUS, but it has no significant effect on MSCI scores. Further, the same indicator shows that the significance level diverges between the RAs as well as the coefficients' amplitudes. The effect of the percentage of women employees on the ESG score and social pillar scores of the RAs is also different. On average, a one percent increase in the percentage of women employees leads to a 0.146 percent increase in BL's ESG score and to an increase of 0.184 percent in BL's social score.

For some results, the direction of the coefficient is not intuitive. For example, all RAs show a positive, albeit small, coefficient for total direct and indirect energy consumption in petajoules (PJ), noted as Energy use. However, higher energy consumption would usually be associated with lower ESG and pillar scores. In addition, some indicators show a significant effect on ESG scores but not on the corresponding pillar score, e.g., on average, a one percent increase in a million tons of CO_2 leads to a 0.015 percent increase in REF's ESG score but has no significant effect on REF's environmental score. Furthermore, semi-elasticities show an overall higher amplitude and significance level than elasticities because of their binary character. Thus, the last group of G-indicators shows highly significant results for all RAs' scores. The ESG score of BL, for example, increases by 20.5 percent in cases where a firm has a CSR committee or a dedicated team installed compared to a firm without such departments. These heterogenic responses in ESG scores to changes in their underlying raw data is in line with the results from baseline hypothesis (H1) on the divergence of ESG scores.

[INSERT TABLE 6 HERE]

Dividing Table 6 into five main geographic regions leads to the display in Table 7. On the horizontal axis, regions are divided into Africa & Middle East, Asia & Pacific, Europe, Latin America & Caribbean, and North America. The first column shows the name of the RA and its corresponding raw data variables. Regional differences can be found across all RAs. Underlying raw data indicators for firms located in Europe show significance most often, except for MSCI. For MSCI, variables from firms headquartered in North America show significance levels most often. These observations corroborate the overall results from Table 6, which shows that MSCI has the lowest number of indicators with a significance level over five percent. Firms located in Africa & Middle East show the fewest indicators with significant effects on the firm's ESG scores. Regional differences in indicators' power to influence ESG scores are intuitive. High reporting and transparency standards, for example in Europe, lead to more valid assessments by the RAs' analysts. Non-disclosure is penalized with inconclusive results for the scores, and non-reported indicators cannot be taken into account to analyze ESG scores. However, different sensitivities in terms of amplitude and significance between the RAs cannot be explained by treating regions differently for each RA.

[INSERT TABLE 7 HERE]

Figure 3 displays elasticity coefficients of ESG scores and different underlying raw variables. The underlying raw variables (*Energy_use*, *CO2*, *Women*, and *Injuries*) are chosen by their significance[12] overall four RAs.[13] All graphs show a divergence of coefficients for the different RAs over the years. For instance, the coefficients in the graphs for *Energy_use* and CO_2 are clearly spreading to a broader spectrum of amplitudes as the years increase. Furthermore, the plots of *Women* and *Injuries* depict a path of convergence to the years 2009 and 2010. After these years, the coefficients diverge again.

Over all four underlying raw variables, the sample with BL's ESG scores has the highest number of observations. In addition, the number of observations over all four underlying raw variables and RAs slightly increases over time. Thus, more information about a firm is gathered.

A further similarity over all four underlying raw variables is the change in coefficients' significance levels. After the year 2010, when the coefficients over the four RAs start to highly diverge, they also become more significant. These observations may be taken from the second plot of each KPI. The lowest significance levels are revealed in the plot for the coefficients on *Injuries*.

The first three plots in Figure 3 show similar coefficients on *Energy_use* for all four RAs around zero until 2010. After the year 2010, the coefficients for all RAs except MSCI reveal an increase when *Energy_use* increases by one percent. The differences between the coefficients for all four RAs, which are displaying around zero or above, and MSCI scores, which are decreasing below zero after 2010, can also be observed for another KPI within the environmental pillar, i.e., CO_2. In this context, positive coefficients are actually counterintuitive, since one assumes that with an increase in *Energy_use* or CO_2 ESG ratings should decrease. Furthermore, these observations are very distinct from the coefficients' behavior in the social pillar over time.

Both underlying raw variables categorized in the social pillar, i.e., *Women* and *Injuries*, show more movement around and below zero compared to the KPIs in the environmental

[12] Please note that the coefficients' amplitude and significance in this graph might differ from Table 6. The plots of these coefficients are estimated by an OLS regression for each year separately, while the regression coefficients of Table 6 are estimated by a fixed-effects panel model with cluster-robust standard-errors.

[13] Please see Appendix C Figure 8 for two more stets of plots of underlying raw variables (*Waste* and *Water*) with less significant coefficients.

pillar. In addition to this comparison, coefficients for *Women* and *Injuries* illustrate that the ones regressed with BL ESG scores are scattered in the lower parts of the plots (below zero), whereas MSCI ESG scores' coefficients are in the upper parts. The three plots depicting the coefficients for *Women* show that MSCI and REF are more likely to increase their ESG scores with an increase in women employees and women in social workforce. However, the data reports negative coefficients for coefficients regressed with BL and SUS in each year. Yearly regressions on *Injuries* indicate that most of the coefficients are scattered in the negative part of the plot, which is intuitive, i.e., ESG scores decline when injuries and fatalities, including no-lost-time injuries relative to one million hours worked, increase.

[INSERT FIGURE 3 HERE]

5 Discussion and conclusion

This study empirically compares the scores of different ESG RAs and intensively investigates their underlying raw data. I study two hypotheses: first, a baseline hypothesis about the divergence of ESG scores to corroborate my samples. Second, the main part of this paper is about the effects to ESG scores of changes in their underlying raw data. Both hypotheses are tested for four well-known RAs: MSCI, REF, SUS, and BL.

The analyses confirm the divergence of ESG scores (H1) and their pillars from different RAs, aligning with prior research. Descriptive statistics, correlations, histograms, and the Wilcoxon signed-rank test validate the differences among the E, S, and G scores from different RA, establishing the dataset's validity. Additionally, testing the main hypothesis (H2) reveals a fundamental disagreement among RAs regarding the usage of underlying raw data. ESG scores react differently to changes in its underlying raw data in terms of magnitude and significance, consistent across regions and time. These results enhance the understanding of the observed differences in ESG scores as per the baseline hypothesis (H1).

This study contributes to a growing body of evidence from practitioners as well as academics on the divergence of ESG scores and scores' transparency. Within this context, this study is the first to explore the relationship between underlying raw data and ESG scores. It is essential for researchers as well as practitioners who work with ESG scores to know that changes in underlying raw data reported by the firms have significantly different effects on the scores. With this insight, I contribute to a growing body of literature in sustainable finance. This strand of literature expands to research of disclosure (Abbott and Monsen, 1979; Lang and Lundholm, 1996), CSR and corporate governance (Jo and Harjoto, 2012; Orlitzky, 2013) and the role of RAs (Avetisyan and Hockerts, 2017; Chatterji, Durand et al., 2016; Chatterji, Levine and Toffel, 2009; Widyawati, 2020; Windolph, 2011).

Further, this study contributes to the expansion of literature on the transparency and understanding of ESG scores as a measurement of sustainability. Prior literature (e.g., Berg, Fabisik and Sautner, 2020; Berg, Kölbel and Rigobon, 2022; Chatterji, Durand et al., 2016; Dumrose et al., 2022) has already contributed a great deal of transparency to important similarities and differences of ESG scores. This study is the first to show over four well-known RAs that the sensitivity of ESG scores and their pillar scores are not equal for each RA. Their heterogeneity is also consistent and not solely explainable by regional and time differences.

The scope of the contribution can be expanded to practical implications. It is crucial for researchers and practitioners to carefully select the appropriate ESG score and RA, as study outcomes are heavily influenced by these choices. Robustness analyses involving multiple ESG scores from one RA can enhance research reliability. However, if focusing on specific firm characteristics, explaining the rationale behind selecting a particular RA is advisable. Alternatively, utilizing the firm's own reported underlying raw data can be a viable strategy, provided the research question permits it.

This study emphasizes the significant impact of RA choice on investment decisions, affecting asset managers and governments alike. Investors can gain a deeper understanding of the relationship between ESG scores and underlying raw data, enabling more informed investment choices. To reduce uncertainty, investors may consider obtaining indicator-level variables from multiple sources. The findings underscore the importance of thorough analysis of ESG score methodologies and drivers, allowing investors to align their investments with their preferences. For those interested in key indicator changes, focusing on the underlying raw data of ESG scores can provide valuable insights.

Firms rated by RAs must prioritize measurements aligned with their sustainability goals, rather than pursuing higher ESG scores. This study reveals that ESG score disparities do not stem from varying underlying raw data, i.e. real firm characteristics. RAs should enhance transparency regarding the use of raw data variables, as inconsistencies affect ESG scores. Consequently, RAs should standardize their approaches to maintain consistency in ESG assessments.

Finally, regulators should establish consistent rules for firms' ESG disclosures to harmonize ESG scores. Improved disclosure practices could standardize the reporting of underlying raw data. Requiring RAs to explain their results in terms of firm-level characteristics, i.e., underlying raw data, would enhance comparability among RAs.

This study's main analyses are performed with the method of sensitivity analyses, which is well-known and widely accepted in literature. However, this regression only included one independent variable of interest. A limitation of this method concerns the completeness of the regression in terms of missing independent variables. Yet, I am not claiming that the analyses are aiming for completeness, but rather to give a basic understanding of the sensitivity of ESG scores to a change in a single underlying raw data variable. To counteract this shortcoming, I performed all analyses with four well-known RAs.

Regulators in the U.S. and Europe are implementing initiatives for sustainable finance (e.g., European Commission, 2021; Lee, 2021), emphasizing the importance of transparency and disclosure standards. These efforts aim to counter misleading information in financial products related to sustainability. With the rise of financial products claiming to impact real-world indicators, it's crucial to scrutinize the relationship between these claims and the underlying raw data reported by firms, necessitating further research in this area.

References

Abbott, W. F., & Monsen, J. R. (1979). On the measurement of corporate social responsibility: Self-reported disclosures as a method of measuring corporate social involvement. *Academy of Management Journal*, *22*(3), 501–515. https://doi.org/10.2307/255740

Auer, B. R., & Schuhmacher, F. (2016). Do socially (ir)responsible investments pay? new evidence from international esg data. *Quarterly Review of Economics and Finance*, *59*, 51–62. https://doi.org/10.1016/j.qref.2015.07.002

Aupperle, K. E., Carroll, A. B., & Hatfield, J. D. (1985). An empirical examination of the relationship between corporate social responsibility and profitability. *Academy of Management Journal*, *28*(2), 446–463. https://doi.org/10.5465/256210

Avetisyan, E., & Ferrary, M. (2013). Dynamics of stakeholders' implications in the institutionalization of the csr field in france and in the united states. *Journal of Business Ethics*, *115*(1), 115–133. https://doi.org/10.1007/s10551-012-1386-3

Avetisyan, E., & Hockerts, K. (2017). The consolidation of the esg rating industry as an enactment of institutional retrogression. *Business Strategy and the Environment*, *26*(3), 316–330. https://doi.org/10.1002/bse.1919

Barnett, M. L. (2007). Stakeholder influence capacity and the variability of financial returns to corporate social responsibility. *Academy of management review*, *32*(3), 794–816. https://doi.org/10.5465/AMR.2007.25275520

Berg, F., Fabisik, K., & Sautner, Z. (2020). Rewriting history ii: The (un) predictable past of esg ratings. *European Corporate Governance Institute–Finance Working Paper*, *708*. https://doi.org/10.2139/ssrn.3722087

Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of esg rating [Online available at https://doi.org/10.1093/rof/rfac033]. *Review of Finance*. https://doi.org/10.2139/ssrn.3438533

Boffo, R., & Patalano, R. (2020). Esg investing: Practices, progress and challenges. *OECD. Available online at https://www. oecd. org/finance/ESG-Investing-Practices-Progress-Challenges. pdf, checked on*, *April 4, 2021*.

Busch, T., Bauer, R., & Orlitzky, M. (2016). Sustainable development and financial markets: Old paths and new avenues. *Business & Society*, *55*(3), 303–329. https://doi.org/10.1177/0007650315570701

Busch, T., & Hoffmann, V. H. (2011). How hot is your bottom line? linking carbon and financial performance. *Business & Society*, *50*(2), 233–265. https://doi.org/10.1177/0007650311398780

Chatterji, A. K., Durand, R., Levine, D. I., & Touboul, S. (2016). Do ratings of firms converge? implications for managers, investors and strategy researchers. *Strategic Management Journal*, *37*(8), 1597–1614. https://doi.org/10.1002/smj.2407

Chatterji, A. K., & Levine, D. I. (2006). Breaking down the wall of codes: Evaluating non-financial performance measurement. *California Management Review*, *48*(2), 29–51. https://doi.org/10.2307/41166337

Chatterji, A. K., Levine, D. I., & Toffel, M. W. (2009). How well do social ratings actually measure corporate social responsibility? *Journal of Economics & Management Strategy*, *18*(1), 125–169. https://doi.org/10.1111/j.1530-9134.2009.00210.x

Chegut, A., Schenk, H., & Scholtens, B. (2011). Assessing sri fund performance research: Best practices in empirical analysis. *Sustainable Development*, *19*(2), 77–94. https://doi.org/10.1002/sd.509

Cho, C. H., Guidry, R. P., Hageman, A. M., & Patten, D. M. (2012). Do actions speak louder than words? an empirical investigation of corporate environmental reputation. *Accounting, organizations and society*, *37*(1), 14–25. https://doi.org/10.1016/j.aos.2011.12.001

Christensen, D. M., Serafeim, G., & Sikochi, A. (2022). Why is corporate virtue in the eye of the beholder? the case of esg ratings. *The Accounting Review*, *97*(1), 147–175. https://doi.org/10.2308/TAR-2019-0506

Clementino, E., & Perkins, R. (2020). How do companies respond to environmental, social and governance (esg) ratings? evidence from italy. *Journal of Business Ethics*, 1–19. https://doi.org/10.1007/s10551-020-04441-4

Curran, M. M., & Moran, D. (2007). Impact of the ftse4good index on firm price: An event study. *Journal of environmental management*, *82*(4), 529–537. https://doi.org/10.1016/j.jenvman.2006.02.010

Delmas, M. A., Etzion, D., & Nairn-Birch, N. (2013). Triangulating environmental performance: What do corporate social responsibility ratings really capture? *Academy of Management Perspectives*, *27*(3), 255–267. https://doi.org/10.5465/amp.2012.0123

Directorate-General for Financial Stability, Financial Services and Capital Markets Union (European Commission), and Environmental Resources Management Ltd. (2020). *Study on sustainability-related ratings, data and research.* Retrieved January 20, 2021, from https://op.europa.eu/en/publication-detail/-/publication/d7d85036-509c-11eb-b59f-01aa75ed71a1

Dorfleitner, G., Halbritter, G., & Nguyen, M. (2015). Measuring the level and risk of corporate responsibility – an empirical comparison of different esg rating approaches. *Journal of Asset Management*, *16*(7), 450–466. https://doi.org/10.1057/jam.2015.31

Doyle, T. M. (2018). Ratings that don't rate: The subjective world of esg ratings agencies. *American Council for Capital Formation.*

Dumrose, M., Rink, S., & Eckert, J. (2022). Disaggregating confusion? the eu taxonomy and its relation to esg rating. *Finance Research Letters*, *48*, 102928. https://doi.org/10.1016/j.frl.2022.102928

Eltogby, M., Brown, K., & Corrigan, G. (2019). Seeking return on esg: Advancing the reporting ecosystem to unlock impact for business and society. *White Paper. World Economic Forum.*

Escrig-Olmedo, E., Fernández-Izquierdo, M., Ferrero-Ferrero, I., Rivera-Lirio, J., & Muñoz-Torres, M. (2019). Rating the raters: Evaluating how esg rating agencies integrate sustainability principles. *Sustainability*, *11*(3), 915. https://doi.org/10.3390/su11030915

European Commission. (2020). *Study on sustainability-related ratings, data and research.* Retrieved August 20, 2021, from https://op.europa.eu/de/publication-detail/-/publication/d7d85036-509c-11eb-b59f-01aa75ed71a1/language-en/format-PDF/source-183474104

European Commission. (2021). *Corporate sustainability reporting.* Retrieved August 19, 2021, from https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

European Sustainable and Responsible Investment Forum (Eurosif). (2018). *European sri study 2018*. Retrieved January 20, 2021, from www.eurosif.org/wp-content/uploads/2018/11/European-SRI-2018-Study-LR.pdf

Fama, E. F., & French, K. R. (2007). Disagreement, tastes, and asset prices. *Journal of financial economics*, *83*(3), 667–689. https://doi.org/10.1016/j.jfineco.2006.01.003

Ginsberg, A. (1988). Measuring and modelling changes in strategy: Theoretical foundations and empirical directions. *Strategic Management Journal*, *9*(6), 559–575. https://doi.org/10.1002/smj.4250090604

Griffin, J. J., & Mahon, J. F. (1997). The corporate social performance and corporate financial performance debate: Twenty-five years of incomparable research. *Business & society*, *36*(1), 5–31. https://doi.org/10.1177/000765039703600102

Haerens, J. (2019). *Esg investing 101: What investors want to know and the role of esg rating agencies* (sustainalize, Ed.). Retrieved April 20, 2019, from https://sustainalize.com/2019/02/esg-investing-101-what-investors-want-to-know-and-the-role-of-esg-rating-agencies/

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management review*, *20*(4), 986–1014.

Hart, S. L., & Ahuja, G. (1996). Does it pay to be green? an empirical examination of the relationship between emission reduction and firm performance. *Business strategy and the Environment*, *5*(1), 30–37. https://doi.org/10.1002/(SICI)1099-0836(199603)5:1⟨30::AID-BSE38⟩3.0.CO;2-Q

Jo, H., & Harjoto, M. A. (2012). The causal effect of corporate governance on corporate social responsibility. *Journal of Business Ethics*, *106*(1), 53–72. https://doi.org/10.1007/s10551-011-1052-1

Lang, M. H., & Lundholm, R. J. (1996). Corporate disclosure policy and analyst behavior. *Accounting review*, 467–492.

Lee, A. H. (2021). *A climate for change: Meeting investor demand for climate and esg information at the sec* (U. Securities & E. Commission, Eds.). Retrieved April 7, 2021, from https://www.sec.gov/news/speech/lee-climate-change

Murè, P., Spallone, M., Mango, F., Marzioni, S., & Bittucci, L. (2021). Esg and reputation: The case of sanctioned italian banks. *Corporate Social Responsibility and Environmental Management*, *28*(1), 265–277. https://doi.org/10.1002/csr.2047

Novethic Research. (2013). *Overview of esg rating agencies*. Retrieved April 7, 2021, from https://www.novethic.com/fileadmin/user_upload/tx_ausynovethicetudes/pdf_complets/2013_overview_ESG_rating_agencies.pdf

Orlitzky, M. (2013). Corporate social responsibility, noise, and stock market volatility. *Academy of Management Perspectives*, *27*(3), 238–254. https://doi.org/10.5465/amp.2012.0097

Ostlund, L. E. (1977). Attitudes of managers toward corporate social responsbility. *California Management Review*, *19*(4), 35–49. https://doi.org/10.2307/41164722

Peloza, J. (2009). The challenge of measuring financial impacts from investments in corporate social performance. *Journal of Management*, *35*(6), 1518–1541. https://doi.org/10.1177/0149206309335188

Rajesh, R., & Rajendran, C. (2020). Relating environmental, social, and governance scores and sustainability performances of firms: An empirical analysis. *Business Strategy and the Environment*, *29*(3), 1247–1267. https://doi.org/10.1002/bse.2429

Robinson, M., Kleffner, A., & Bertels, S. (2011). Signaling sustainability leadership: Empirical evidence of the value of djsi membership. *Journal of business ethics*, *101*(3), 493–505. https://doi.org/10.1007/s10551-011-0735-y

Rowley, T., & Berman, S. (2000). A brand new brand of corporate social performance. *Business & society*, *39*(4), 397–418. https://doi.org/10.1177/000765030003900404

Saadaoui, K., & Soobaroyen, T. (2018). An analysis of the methodologies adopted by csr rating agencies. *Sustainability Accounting, Management and Policy Journal*, *9*(1), 43–62. https://doi.org/10.1108/SAMPJ-06-2016-0031

Sandberg, J., Juravle, C., Hedesström, T. M., & Hamilton, I. (2008). The heterogeneity of socially responsible investment. *Journal of Business Ethics*, *87*(4), 519–533. https://doi.org/10.1007/s10551-008-9956-0

Scalet, S., & Kelly, T. F. (2010). Csr rating agencies: What is their global impact? *Journal of Business Ethics*, *94*(1), 69–88. https://doi.org/10.1007/s10551-009-0250-6

Schröder, M. (2007). Is there a difference? the performance characteristics of sri equity indices. *Journal of Business Finance & Accounting*, *34*(1-2), 331–348. https://doi.org/10.1111/j.1468-5957.2006.00647.x

Siegel, D. S., & Vitaliano, D. F. (2007). An empirical analysis of the strategic use of corporate social responsibility. *Journal of Economics & Management Strategy*, *16*(3), 773–792. https://doi.org/10.2139/ssrn.900521

Slager, R., Gond, J.-P., & Moon, J. (2012). Standardization as institutional work: The regulatory power of a responsible investment standard. *Organization Studies*, *33*(5-6), 763–790. https://doi.org/10.1177/0170840612443628

Statman, M. (2005). Socially responsible indexes: Composition and performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.705344

SustainAbility. (2020). *Rate the raters 2020: Investor survey and interview results*. Retrieved April 7, 2021, from https://www.sustainability.com/globalassets/sustainability.com/thinking/pdfs/sustainability-ratetheraters2020-report.pdf

Teoh, S. H., Welch, I., & Wazzan, C. P. (1991). The effect of socially activist investment pol-icies on the financial markets: Evidence from the south african boycott. *Journal of Business*, *72*(1), 35–89. https://doi.org/10.1086/209602

Eccles, R. G., & Stroehle, J. C. (2018). Exploring social origins in the construction of esg measures. *Available at SSRN 3212685*. https://doi.org/10.2139/ssrn.3212685

Eccles, R. G., Lee, L.-E., & Stroehle, J. C. (2020). The social origins of esg: An analysis of innovest and kld. *Organization & Environment*, *33*(4), 575–596. https://doi.org/10.2139/ssrn.3318225

Ullmann, A. A. (1985). Data in search of a theory: A critical examination of the relationships among social performance, social disclosure, and economic performance of u.s. firms. *Academy of Management Review*, *10*(3), 540–557. https://doi.org/10.5465/amr.1985.4278989

Waddock, S. A., & Graves, S. B. (1997). The corporate social performance-financial performance link. *Strategic Management Journal*, (4), 303–319. https://doi.org/10.1002/(SICI)1097-0266(199704)18:4⟨303::AID-SMJ869⟩3.0.CO;2-G

Wagner, M. (2010). The role of corporate sustainability performance for economic performance: A firm-level analysis of moderation effects. *Ecological Economics*, *69*(7), 1553–1560. https://doi.org/10.1016/j.ecolecon.2010.02.017

Widyawati, L. (2020). Measurement concerns and agreement of environmental social governance ratings. *Accounting & Finance*. https://doi.org/10.1111/acfi.12638

Windolph, S. E. (2011). Assessing corporate sustainability through ratings: Challenges and their causes. *Journal of Environmental Sustainability*, *1*(1), 1–22. https://doi.org/10.14448/jes.01.0005

Wood, D. J. (1991). Corporate social performance revisited. *Academy of Management Review*, *16*(4), 691–718. https://doi.org/10.5465/amr.1991.4279616

Tables

Table 1: Variable definition of measures of aggregated and ESG pillars

Variable	Definition
MSCI	
msci_ESG$_{i,t}$	MSCI's overall ESG score in a given year t for firm i;
msci_ENV$_{i,t}$	MSCI's environmental score in a given year t for firm i;
msci_SOC$_{i,t}$	MSCI's social score in a given year t for firm i;
msci_GOV$_{i,t}$	MSCI's governance score in a given year t for firm i;
Sustainalytics	
sus_ESG$_{i,t}$	Sustainalytics' overall ESG score in a given year t for firm i;
sus_ENV$_{i,t}$	Sustainalytics' environmental score in a given year t for firm i;
sus_SOC$_{i,t}$	Sustainalytics' social score in a given year t for firm i;
sus_GOV$_{i,t}$	Sustainalytics' governance score in a given year t for firm i;
Bloomberg	
bl_ESG$_{i,t}$	Bloomberg's overall ESG score in a given year t for firm i;
bl_ENV$_{i,t}$	Bloomberg's environmental score in a given year t for firm i;
bl_SOC$_{i,t}$	Bloomberg's social score in a given year t for firm i;
bl_GOV$_{i,t}$	Bloomberg's governance score in a given year t for firm i;
Refinitiv	
ref_ESG$_{i,t}$	Refinitiv's combined ESG score in a given year t for firm i;
ref_ENV$_{i,t}$	Refinitiv's environmental score in a given year t for firm i;
ref_SOC$_{i,t}$	Refinitiv's social score in a given year t for firm i;
ref_GOV$_{i,t}$	Refinitiv's governance score in a given year t for firm i.

Notes: This table summarizes measures of aggregated scores and each pillar of ESG and its denotation.

Table 2: Final list of reported underlying raw data variables (author)

Underlying raw variable	Definition	ESG dimension
Energy_use	Total direct and indirect energy consumption in petajoules (PJ)	Environmental (Climate Change, Natural resource use)
Renew_energy_use	Does the firm make use of renewable energy? (Yes=1)	Environmental (Climate change)
Waste	Total amount of waste produced in a million tons	Environmental (Waste)
Water	Total water withdrawal in a million cubic meters	Environmental (Natural resource use)
CO_2	Total CO_2 and CO_2 equivalents emission in a million tons	Environmental (Climate change)
NOx	Total amount of NOx emissions emitted in a thousand tons	Environmental (Climate change)
Emission_pol	Does the firm have a policy to reduce emissions? (Yes=1)	Environmental (Climate change)
Women	Percentage of women employees	Social (Workforce)
Injuries	Total number of injuries and fatalities including no-lost-time injuries relative to one million hours worked	Social (Workforce, Occupational health and safety)
HR_pol	Does the firm have a policy to guarantee the freedom of association universally applied, independent of local laws? AND Does the firm have a policy for the exclusion of child, forced or compulsory labor? (Yes=1)	Social (Human rights)
HR_supply_pol	Does the firm have a human rights policy applying to its supply chain? (Yes=1)	Social (Human rights, Supply Chain)
CSR	Does the firm have a CSR committee or team? (Yes=1)	Governance (Corporate governance, Sustainability oversight)
CSR_report	Does the firm publish a separate CSR, Health and Safety, Sustainability report or publish a section in its annual report on CSR, Health and Safety, Sustainability? (Yes=1)	Governance (Sustainability oversight)
UNGC	Has the firm signed the UN Global Compact? (Yes=1)	Governance (Ethics)

Notes: This table presents the final list of underlying raw data variables for further analyses. It shows the name of each variable, its description, and its categorization to the E, S, or G pillar.

Table 3: Descriptive statistics: Final data with matching underlying raw data

	Obs	Mean	SD	Skew	Kurt	Min	0.25	Med	0.75	Max
MSCI										
msci_ESG	43593	46.5	22.8	0.2	2.5	0.0	29.0	45.1	62.8	100.0
msci_ENV	43585	48.2	20.5	0.2	2.7	0.0	33.8	47.9	61.9	100.0
msci_SOC	43593	46.0	17.3	-0.0	3.1	0.0	35.0	46.0	57.2	100.0
msci_GOV	43570	54.8	19.6	0.1	2.9	0.0	41.7	54.3	67.8	100.0
Sustainalytics										
sus_ESG	33403	56.6	9.9	0.6	2.8	27.0	49.0	55.0	63.2	100.0
sus_ENV	33403	53.7	13.8	0.5	2.5	15.0	42.4	51.9	63.4	100.0
sus_SOC	33403	56.5	11.1	0.4	2.9	20.3	48.3	55.5	63.4	100.0
sus_GOV	33403	61.5	10.9	0.2	2.7	26.3	53.5	61.0	69.0	100.0
Bloomberg										
bl_ESG	56968	22.8	13.8	1.1	3.3	0.8	11.8	17.5	31.4	83.1
bl_ENV	32582	23.0	16.7	0.6	2.4	0.8	8.5	18.6	36.4	90.2
bl_SOC	42627	25.4	17.0	0.8	3.1	3.1	11.7	22.8	35.1	94.7
bl_GOV	20051	47.2	9.5	-0.4	4.9	3.6	42.9	48.2	51.8	85.7
Refinitiv										
ref_ESG	50629	50.3	17.5	0.1	2.2	0.0	36.5	49.6	63.8	97.5
ref_ENV	25893	49.9	23.2	0.2	1.9	2.9	29.8	48.2	69.1	99.2
ref_SOC	23673	50.5	22.0	0.0	2.1	2.5	33.2	50.2	67.9	98.8
ref_GOV	53251	49.9	30.3	0.0	1.5	2.5	20.4	49.3	79.3	98.2

Notes: This table presents the descriptive statistics of the cross-sectional data, i.e., means averaged over the observation period. It shows the total number of observations (Obs), the mean, the standard deviation (SD), the skewness (Skew), the kurtosis (Kurt), the minimum, the quartiles, and the maximum for each variable.

Table 4: Descriptive statistics: Measures of underlying raw data

	Obs	Mean	SD	Skew	Kurt	Min	Max
Energy_use (in PJ)	18298	41.7	192.7	18.3	585.2	0.0	9823.6
Renew_energy_use (Y/N)	48571	0.3	0.5	0.7	1.5	0.0	1.0
Waste (Mio. t)	14130	12.8	119.7	13.5	202.9	0.0	2514.6
Water (Mio. m^3)	16479	1298.0	137667.1	128.3	16468.3	0.0	1.8e+07
CO_2 (Mio. t)	21916	7.4	327.8	104.3	10905.3	0.0	34542.0
NOx (Th. t)	6972	29.8	267.4	31.7	1138.7	0.0	11152.1
Emission_pol (Y/N)	48559	0.5	0.5	-0.0	1.0	0.0	1.0
Women (%)	19717	34.4	18.2	0.4	2.6	0.0	98.0
Injuries (tot/1 Mio. h)	10651	7.3	12.2	6.4	76.3	0.0	268.6
HR_pol (Y/N)	48560	0.2	0.4	1.3	2.6	0.0	1.0
HR_supply_pol (Y/N)	48560	0.2	0.4	1.9	4.6	0.0	1.0
CSR (Y/N)	48571	0.5	0.5	0.1	1.0	0.0	1.0
CSR_report (Y/N)	48571	0.5	0.5	0.0	1.0	0.0	1.0
UNGC (Y/N)	48571	0.2	0.4	1.9	4.6	0.0	1.0

Notes: This table presents the descriptive statistics of the underlying raw data, i.e., means averaged over the observation period. It shows the total number of observations (Obs), the mean, the standard deviation (SD), the skewness (Skew), the kurtosis (Kurt), the minimum, and the maximum for each variable.

Table 5: Wilcoxon signed-rank test results of ESG scores

ESG overall scores	All obs	Z-score	P-value
sus_ESG - msci_ESG	22223	58.583	0.000
bl_ESG - msci_ESG	25755	-116.887	0.000
bl_ESG - sus_ESG	25095	-137.053	0.000
bl_ESG - ref_ESG	29788	-147.011	0.000
ref_ESG - msci_ESG	32303	48.012	0.000
ref_ESG - sus_ESG	26587	-25.517	0.000

Notes: This table presents the results of the Wilcoxon signed-rank test for matched-pairs. It shows the total number of all observations (positive, negative signs and zero) (All obs), the z-score (Z-score), and the p-value (P-value) of the test for each comparison.

Table 6: (Semi-)elasticities of underlying raw data on ESG scores

	Bloomberg		Refinitiv		Sustainalytics		MSCI	
Environmental								
	ESG	ENV	ESG	ENV	ESG	ENV	ESG	ENV
Energy_use	0.017*	0.037**	0.010***	0.004	0.007**	0.010**	0.006	0.010*
	(12594)	(11779)	(18160)	(9935)	(12561)	(12561)	(13365)	(13499)
i.Renew_energy	0.205***	0.241***	0.182***	0.277***	0.055***	0.082***	0.098***	0.059***
	(29852)	(19802)	(48307)	(25719)	(26098)	(26098)	(30210)	(30718)
Waste	0.037***	0.051***	0.004	-0.005	0.012***	0.012***	0.002	-0.005
	(9944)	(9523)	(14021)	(7649)	(10008)	(10008)	(10551)	(10646)
Water	0.026**	0.043***	0.009***	0.001	0.010***	0.011***	0.008	0.001
	(11455)	(10786)	(16374)	(9204)	(11500)	(11500)	(12167)	(12286)
CO2	0.023*	0.050**	0.015***	0.012	0.007*	0.007	0.002	-0.002
	(14971)	(13922)	(21681)	(11364)	(15096)	(15096)	(16014)	(16167)
NOx	-0.018	-0.009	-0.004	-0.007	-0.005	-0.007	-0.009	-0.007
	(4753)	(4625)	(6796)	(3898)	(4777)	(4777)	(5167)	(5223)
i.Emission_pol	0.076***	0.050	0.150***	0.357***	0.025***	0.029***	0.161***	0.099***
	(29846)	(19800)	(48295)	(25719)	(26098)	(26098)	(30209)	(30717)
Social								
	ESG	SOC	ESG	SOC	ESG	SOC	ESG	SOC
Women	0.146***	0.184***	0.098***	0.077**	0.023*	0.034*	0.077	0.016
	(13825)	(11978)	(19581)	(10673)	(13126)	(13126)	(13587)	(13711)
Injuries	-0.121***	-0.180***	-0.049***	-0.060***	-0.037***	-0.042***	-0.075**	0.021
	(6974)	(6273)	(10112)	(5742)	(6896)	(6896)	(7450)	(7521)
i.HR_pol	0.296***	0.390***	0.187***	0.227***	0.083***	0.107***	0.108***	0.040***
	(29852)	(19802)	(48301)	(25714)	(26098)	(26098)	(30202)	(30710)
i.HR_supply_pol	0.215***	0.302***	0.116***	0.186***	0.076***	0.083***	0.072***	0.022
	(29852)	(19802)	(48301)	(25714)	(26098)	(26098)	(30202)	(30710)
Governance								
	ESG	GOV	ESG	GOV	ESG	GOV	ESG	GOV
i.CSR	0.205***	0.270***	0.213***	0.305***	0.042***	0.065***	0.091***	0.052***
	(29852)	(19802)	(48307)	(25719)	(26098)	(26098)	(30210)	(30718)
i.CSR_report	0.272***	0.398***	0.262***	0.389***	0.058***	0.082***	0.138***	0.052***
	(29852)	(19802)	(48307)	(25719)	(26098)	(26098)	(30210)	(30718)
i.UNGC	0.257***	0.336***	0.144***	0.178***	0.079***	0.096***	0.096***	0.058***
	(29852)	(19802)	(48307)	(25719)	(26098)	(26098)	(30210)	(30718)

Notes: This table presents elasticities of underlying raw data on ESG scores. Elasticities are shown for all continuous variables of raw data; for binary variables of underlying raw data, semi-elasticities were calculated. The models are estimated by a fixed-effects panel estimation with cluster-robust standard-errors. The data transformation for elasticities was obtained by taking the natural logarithm. The table is divided into three parts: Environmental, Social, and Governance variables. The numbers in parentheses present the number of observations for each model. The stars indicate the significance levels as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: (Semi-)elasticities of underlying raw data on ESG sores by region

	Africa & Middle East	Asia & Pacific	Europe	Latin America & Caribbean	North America
MSCI					
Energy_use	0.024	−0.001	−0.001	0.175**	0.004
Waste	0.035	−0.012	−0.010	0.014	0.042*
Water	0.045	0.007	−0.003	0.031	0.013
CO2	0.115	0.013	−0.015	0.059	0.007
NOx	0.157	0.022	−0.014	−0.024	−0.060*
Women	−0.373	0.041	0.082	0.710	0.124
Injuries	0.077	−0.076	−0.056	−0.121	−0.116**
i.Renew_energy	0.042	0.123***	0.085***	0.122	0.084**
i.Emission_pol	0.128	0.183***	0.170**	0.340*	0.130*
i.HR_pol	0.011	0.105***	0.096***	0.071	0.145***
i.HR_supply_pol	0.136	0.084	0.026	0.040	0.115**
i.CSR	−0.016	0.129***	0.096***	0.141*	0.042
i.CSR_report	0.015	0.166***	0.176***	0.103	0.096***
i.UNGC	−0.060	0.066*	0.103***	−0.095	0.220***
Sustainalytics					
Energy_use	−0.018	0.006*	0.014**	0.006	0.000
Waste	0.016	0.009**	0.016***	0.006	0.016*
Water	0.011	0.013**	0.011**	0.012	0.003
CO2	0.003	0.013*	0.000	0.026**	0.005
NOx	0.042***	−0.005	−0.010	−0.003	0.000
Women	−0.007	0.023	0.049*	−0.016	−0.035
Injuries	−0.020	−0.014*	−0.061***	−0.008	−0.08 ***
i.Renew_energy	0.041*	0.046***	0.068***	0.017	0.062***
i.Emission_pol	−0.005	−0.015*	0.028*	0.070*	0.087***
i.HR_pol	0.083***	0.071***	0.097***	0.042**	0.086***
i.HR_supply_pol	0.023	0.062***	0.076***	0.083*	0.086***
i.CSR	0.049	0.047***	0.034***	0.042***	0.042***
i.CSR_report	−0.026	0.053***	0.074***	0.035***	0.061***
i.UNGC	0.079**	0.073***	0.104***	0.014	0.067***

(cont. on next p.)

Table 7: (Semi-)elasticities of underlying raw data on ESG sores by region – continued

	Africa & Middle East	Asia & Pacific	Europe	Latin America & Caribbean	North America
Bloomberg					
Energy_use	0.061	0.005	0.034***	0.006	0.020
Waste	0.053	0.050***	0.012	0.015	0.066***
Water	−0.018	0.032	0.025**	0.038*	0.008
CO2	0.072	0.038	0.006	0.086	−0.003
NOx	0.099	−0.005	−0.046*	0.001	−0.015
Women	0.185	0.136**	0.176**	0.307	0.054
Injuries	−0.134*	−0.067***	−0.134***	−0.172***	−0.278***
i.Renew_energy	0.113**	0.222***	0.191***	0.247***	0.199***
i.Emission_pol	−0.105	0.023	0.039	0.380***	0.236***
i.HR_pol	0.279***	0.292***	0.282***	0.311***	0.333***
i.HR_supply_pol	0.133*	0.195***	0.197***	0.314***	0.253***
i.CSR	0.260***	0.177***	0.247***	0.128***	0.222***
i.CSR_report	0.132	0.305***	0.278***	0.222***	0.237***
i.UNGC	0.221**	0.235***	0.274***	0.260***	0.277***
Refinitiv					
Energy_use	−0.007	0.009	0.014**	0.010	0.008
Waste	0.005	−0.002	0.013**	−0.004	0.006
Water	0.014	0.012*	0.008	0.013	0.005
CO2	−0.011	0.015*	0.011*	0.028	0.019*
NOx	0.030	−0.017*	0.013	0.004	−0.006
Women	0.069	0.126***	0.090**	0.117*	0.011
Injuries	−0.032	−0.032***	−0.060***	−0.045**	−0.085***
i.Renew_energy	0.126***	0.202***	0.149***	0.255***	0.183***
i.Emission_pol	0.033	0.106***	0.127***	0.251***	0.222***
i.HR_pol	0.115***	0.232***	0.144***	0.241***	0.188***
i.HR_supply_pol	0.096**	0.114***	0.098***	0.124***	0.141***
i.CSR	0.239***	0.261***	0.161***	0.271***	0.194***
i.CSR_report	0.230***	0.305***	0.234***	0.329***	0.223***
i.UNGC	0.108**	0.146***	0.152***	0.142***	0.128***

Notes: This table presents elasticities of underlying raw data on ESG scores by regions. Elasticities are shown for all continuous variables of underlying raw data; for binary variables of underlying raw data, semi-elasticities were calculated. The models are estimated by a fixed-effects panel estimation with robust standard-errors. The data transformation for elasticities was obtained by taking the natural logarithm. The table is divided in four sections, each showing one RA. The numbers in parentheses present the number of observations for each model. The stars indicate the significance levels as follows: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figures

Figure 1: Common ESG issues (European Commission (2020))

Environmental	Social	Governance
• Climate change	• Workforce	• Corporate governance
• Natural resource use	• Occupational health and safety	• Risk management
• Waste	• Product responsibility	• Ethics
• Product stewardship	• Human rights	• Shareholder rights
	• Supply chain	• Sustainability oversight

Figure 2: ESG score histograms

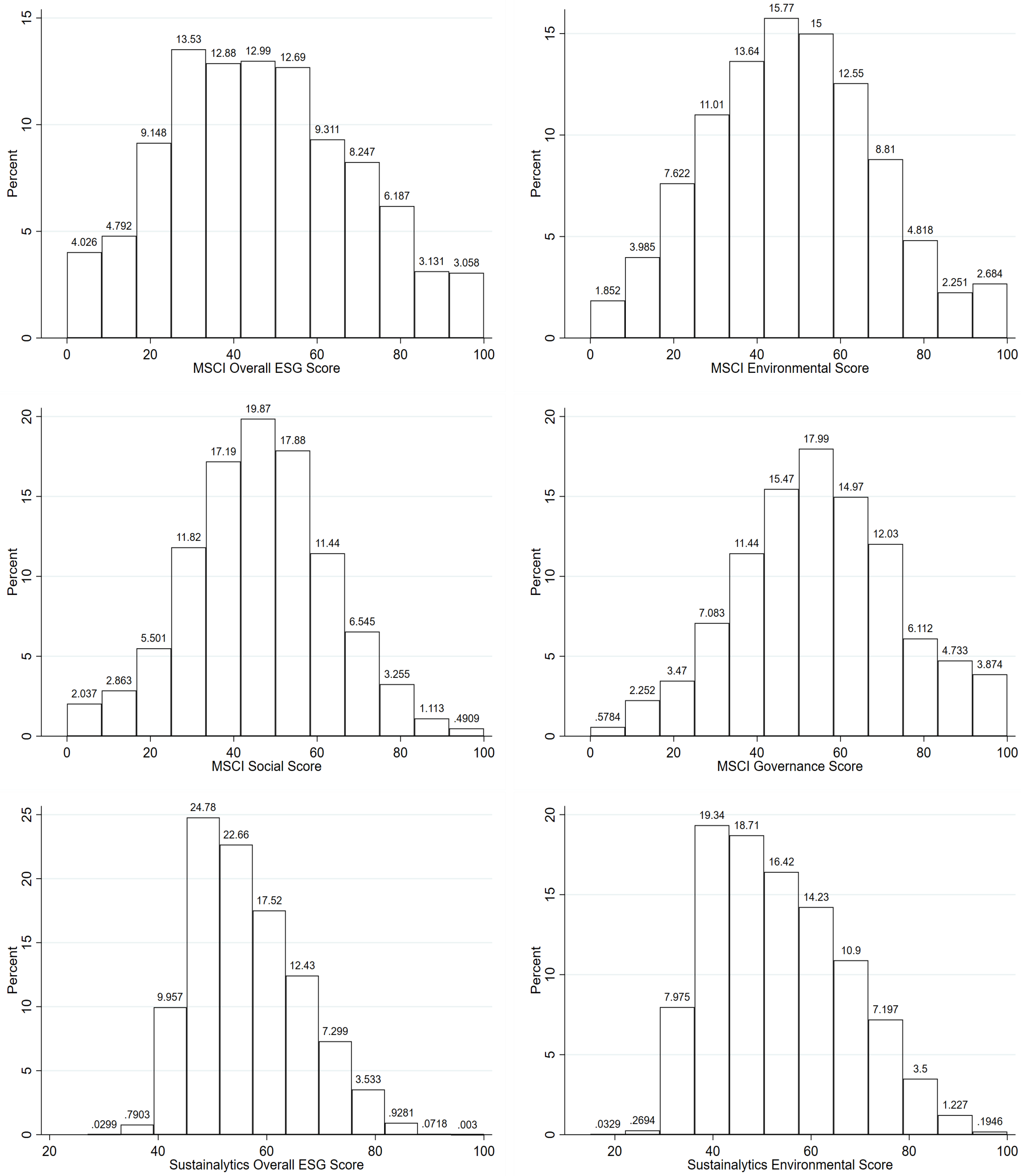


Figure 2: ESG score histograms (continued)

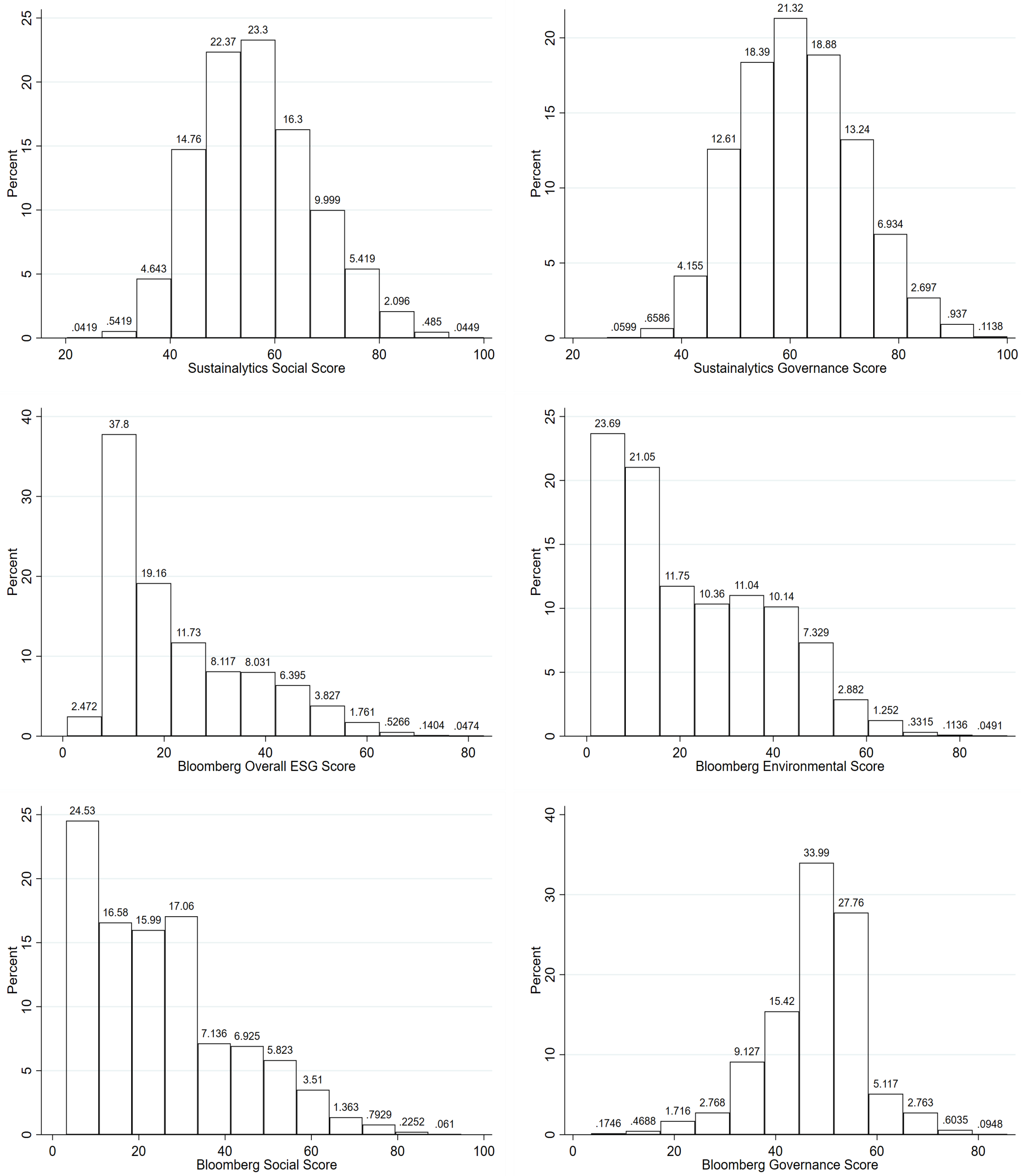
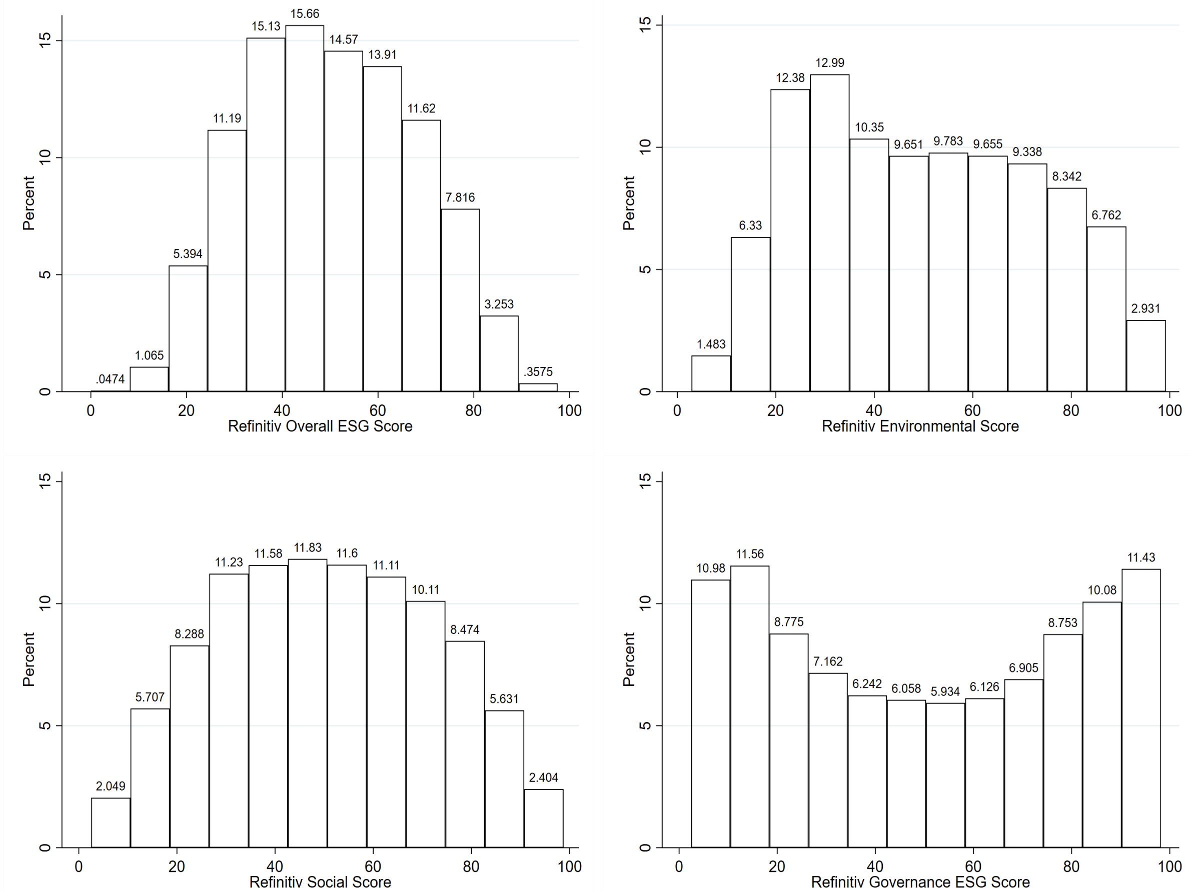


Figure 2: ESG score histograms (continued)



Notes: This figure depicts the histograms for each score type for all four RAs. The histograms consist of the full data set available. The vertical axis shows the frequency in percentage, and the horizontal axis denotes the scores between 0 and 100. The ESG scores of zero to 100 are divided equally into twelve bars.

Figure 3: Elasticity coefficients of ESG scores and underlying raw variables (2007-2018)

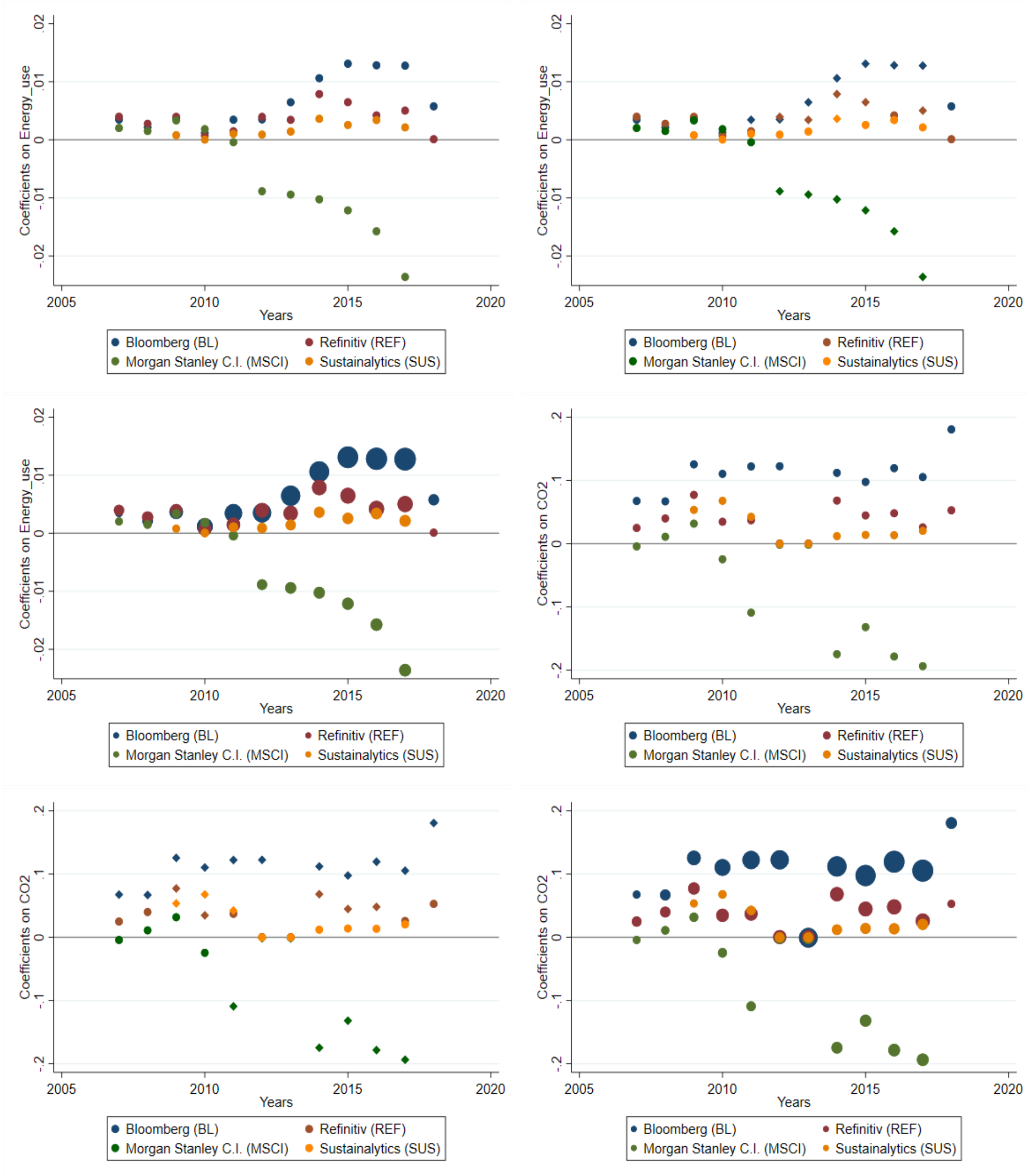
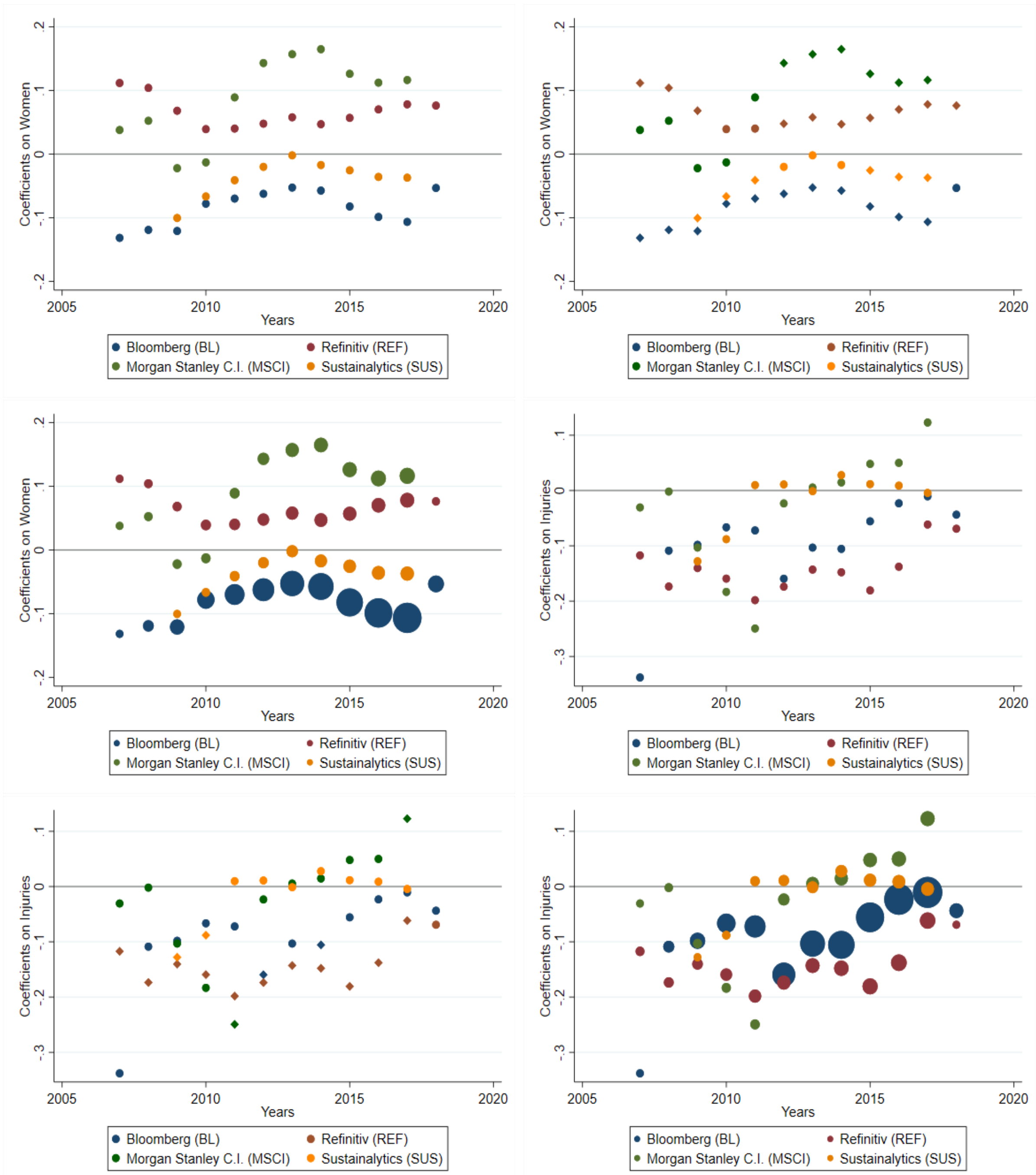


Figure 3: Elasticity coefficients of ESG scores and underlying raw variables (2007-2018) (continued)



Notes: This figure depicts the time plots for the elasticity coefficients on various underlying raw variables from 2007 to 2018. The models are estimated by OLS regression estimation for each year separately. The data transformation for elasticities was obtained by taking the natural logarithm. The coefficients' amplitudes are displayed on the y-axis on the different underlying raw variables, whereas the time span is shown on the x-axis. In the second plots of each underlying raw variable, the routes represent coefficients that are significantly different from zero (with p<0.05). In the respective third plot, the diameters of the coefficients are relative to the respective estimation sample sizes.

6 Appendix A. Descriptive statistics: Full samples of ESG scores

Table A1: Descriptive statistics: Full samples

	Obs	Mean	SD	Skew	Kurt	Min	0.25	Med	0.75	Max
Bloomberg										
bl_ESG	77798	20.9	13.0	1.3	4.0	0.8	11.2	15.7	26.9	83.1
bl_ENV	41420	20.9	16.3	0.8	2.7	0.8	7.0	15.5	33.3	90.2
bl_SOC	56314	23.3	16.4	0.9	3.4	3.1	8.8	19.3	33.3	94.7
bl_GOV	25959	45.9	9.5	-0.4	4.7	3.6	41.1	46.4	51.8	85.7
Refinitiv										
ref_ESG	52320	50.1	17.5	0.1	2.2	0.0	36.3	49.3	63.6	97.5
ref_ENV	25952	49.9	23.2	0.2	1.9	2.9	29.8	48.2	69.1	99.2
ref_SOC	23693	50.5	22.0	0.0	2.1	2.5	33.1	50.2	67.9	98.8
ref_GOV	53342	49.8	30.3	0.0	1.5	2.5	20.4	49.3	79.3	98.2
Sustainalytics										
sus_ESG	36462	56.9	10.1	0.6	2.7	27.0	49.0	55.2	63.6	100.0
sus_ENV	36462	54.0	14.0	0.5	2.5	15.0	42.6	52.2	64.0	100.0
sus_SOC	36462	56.8	11.3	0.4	2.9	20.3	48.6	56.0	64.0	100.0
sus_GOV	36462	61.4	11.1	0.2	2.6	26.3	53.3	61.0	69.0	100.0
MSCI										
msci_ESG	73722	46.9	22.7	0.2	2.5	0.0	29.8	45.5	63.1	100.0
msci_ENV	73709	49.3	21.5	0.1	2.6	0.0	34.0	49.3	64.3	100.0
msci_SOC	73724	45.8	17.0	0.0	3.2	0.0	35.0	46.0	56.6	100.0
msci_GOV	73661	53.0	20.6	0.1	2.8	0.0	39.7	52.8	66.7	100.0

Notes: This table presents the descriptive statistics of the full samples for measures of aggregated scores and each pillar of ESG. It shows the total number of observations (Obs), the mean, the standard deviation (SD), the skewness (Skew), the kurtosis (Kurt), the minimum, the quartiles and the maximum for each variable.

7 Appendix B. ESG scores Spearman rank correlation

Table A2: ESG scores correlations

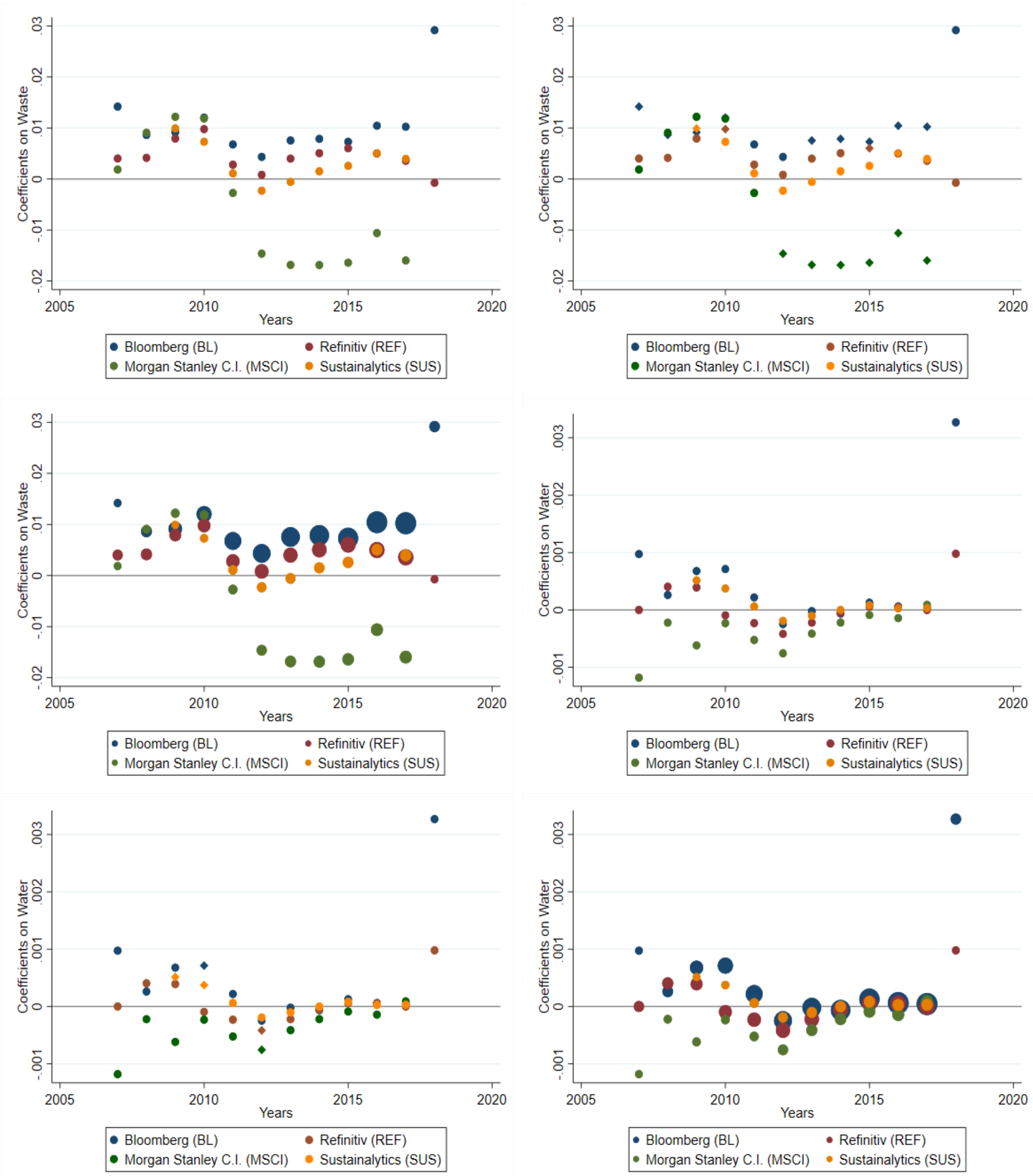
	Bloomberg				Refinitiv				Sustainalytics				MSCI			
	bl_ESG	bl_ENV	bl_SOC	bl_GOV	ref_ESG	ref_ENV	ref_SOC	ref_GOV	sus_ESG	sus_ENV	sus_SOC	sus_GOV	msci_ESG	msci_ENV	msci_SOC	msci_GOV
Bloomberg																
bl_ESG	1.00															
bl_ENV	0.96***	1.00														
bl_SOC	0.86***	0.73***	1.00													
bl_GOV	0.62***	0.50***	0.44***	1.00												
Refinitiv																
ref_ESG	0.55***	0.52***	0.47***	0.40***	1.00											
ref_ENV	0.52***	0.50***	0.44***	0.33***	0.83***	1.00										
ref_SOC	0.52***	0.49***	0.46***	0.37***	0.86***	0.68***	1.00									
ref_GOV	0.24***	0.23***	0.20***	0.19***	0.46***	0.40***	0.41***	1.00								
Sustainalytics																
sus_ESG	0.67***	0.64***	0.59***	0.44***	0.56***	0.51***	0.55***	0.23***	1.00							
sus_ENV	0.60***	0.59***	0.51***	0.36***	0.53***	0.53***	0.51***	0.21***	0.87***	1.00						
sus_SOC	0.58***	0.54***	0.54***	0.38***	0.45***	0.41***	0.45***	0.17***	0.86***	0.59***	1.00					
sus_GOV	0.47***	0.43***	0.43***	0.39***	0.39***	0.27***	0.37***	0.20***	0.74***	0.48***	0.51***	1.00				
MSCI																
msci_ESG	0.39***	0.37***	0.38***	0.20***	0.46***	0.44***	0.43***	0.24***	0.52***	0.48***	0.41***	0.36***	1.00			
msci_ENV	0.25***	0.24***	0.23***	0.14***	0.34***	0.35***	0.33***	0.16***	0.37***	0.44***	0.21***	0.24***	0.55***	1.00		
msci_SOC	0.23***	0.22***	0.23***	0.10***	0.28***	0.27***	0.29***	0.24***	0.29***	0.26***	0.23***	0.23***	0.63***	0.23***	1.00	
msci_GOV	0.09***	0.08***	0.10***	0.06**	0.19***	0.14***	0.17***	0.17***	0.23***	0.14***	0.20***	0.24***	0.43***	0.14***	0.20***	1.00

Notes: This table reports the Spearman rank correlations of ESG score samples BL, REF, SUS, and MSCI.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

8 Appendix C. Elasticity coefficients of ESG scores and underlying raw variables (2007-2018)

Figure 4: Elasticity coefficients of ESG scores and underlying raw variables (2007-2018)



Notes: This figure depicts the time plots for the elasticity coefficients on various underlying raw variables from 2007 to 2018. The models are estimated by OLS regression estimation for each year separately. The data transformation for elasticities was obtained by taking the natural logarithm. The coefficients' amplitudes are displayed on the y-axis on the different underlying raw variables, whereas the time span is shown on the x-axis. In the second plots of each underlying raw variable, the routes represent coefficients that are significantly different from zero (with p<0.05). In the respective third plot, the diameters of the coefficients are relative to the respective estimation sample sizes.

Appendix C. Third research paper

Don’t foul your own nest! But who cares about the rest? CEOs’ ecological embeddedness and corporate releases

Don't foul your own nest! But who cares about the rest? CEOs' ecological embeddedness and corporate pollution

Wiebke Szymczak Simone A. Wagner

November 2023

Abstract

Do managers foul or spare their own nests when it comes to corporate pollution? Ecological embeddedness suggests that managers who are immersed in their environments adopt more environmentally friendly corporate policies. Based on this conjecture, we derive and test the intuitive hypothesis that the physical distance between corporate control and corporate production predicts the extent of corporate pollution attributable to a firm. To this end, we construct a data set of 19,309 facility-year observations using facility-level toxic releases from U.S. firms between 1994 and 2018. Supporting our hypothesis, we find that facilities and firms located close to their CEOs' birthplaces pollute less, both in absolute and relative terms. Intriguingly, aggregate corporate releases are higher when a firm's CEO was born close to one or several corporate facilities, and for firms whose operations are spread out across many facilities. This suggests that CEOs selectively spare their own nest, possibly shifting polluting activities to other facility locations or off-site.

The most recent report by the Lancet Commission on pollution and health finds that pollution is responsible for approximately nine million deaths annually worldwide, making it the world's largest environmental risk factor for disease and premature death (Fuller et al., 2022). While environmental regulation in developed countries has tightened over time, evidence of the geographical distribution of industrial pollution shows that developed countries have reduced domestic pollution by shifting high-pollution activities to developing countries (Moran and Kanemoto, 2016). Although some pollutants can travel substantial distances, the most severe consequences occur in the close vicinity of where pollutants are emitted. Hence, by increasing the physical distance between a firm and where the environmental consequences of that firm's actions are located, it is possible to enjoy economic benefits, such as cheap production costs, without facing the costs of industrial pollution, including adverse health impacts, diminished quality of life, and so on. As the common saying goes "out of sight, out of mind", as people generally prefer to remain ignorant of the adverse impacts they inflict upon others (Dana et al., 2007). Since both the actual and psychological impact of these adverse impacts diminishes for decision-makers as the physical distance between themselves and the consequences of their actions increases, behavioral research finds that people discount these consequences more when they are geographically remote (e.g., Weber, 2010).

In line with these insights, Whiteman and Cooper (2000) introduce the concept of ecological embeddedness, which emphasizes the interconnectedness of human activities and ecosystems within a broader environmental context. Drawing on evidence from an ethnographic study of a beaver hunter,Whiteman and Cooper (ibid.) posit that ecological embeddedness is an important moderator of the environmental behavior of managers. According to their account, four preconditions give rise to a manager's ecological embeddedness: a personal identification with the land, respect for the natural environment, knowledge of the land, and a physical presence in the land. While the importance of place attachment – one of the pillars of ecological embeddedness – has received a lot of attention in environmental psychology (Lewicka, 2011), applying this concept to modern corporations is not straightforward. One particular difficulty is that large corporations generally have multiple offices and production sites spread out across numerous counties within the U.S. or even across different countries.

In this study, we explore how the spatial relationship between the place of control (i.e., corporate headquarters (HQ)) and the place of production (i.e., facilities) affects corporate environmental outcomes. To this end, we obtain latitude and longitude data as well as the corporate pollution statistics for facilities covered by the Toxics Release Inventory (TRI), which is maintained by the U.S. Environmental Protection Agency (EPA). The TRI constitutes an extensive data set of raw statistics about facility-level toxic releases by chemical, providing a valuable resource for studying corporate environmental outcomes (e.g., Xu and Kim, 2022). We match these data with corporate HQ locations and firm-level statistics for the respective parent companies obtained from S&P Compustat via Wharton Research Data Services (WRDS). Our data set spans 25 years, covering the period from 1994 through 2018. To capture the psychological dynamics underlying place attachment, we employ the concept of CEO locality and suppose that CEOs will personally identify with the land close to their birthplaces. Therefore, we complement our data set with hand-collected data about CEOs' birthplaces. In line with the conjecture that CEOs will mitigate environmental impacts on land to which they are attached, the results from our regression analyses reveal that facilities near birthplaces of the parent firms' CEOs tend to pollute less. However, this does not translate into a reduction in a company's overall total toxic releases. Quite literally, CEOs in our sample appear reluctant to foul their own "nest", but are willing to shift corporate pollution to other facilities. Interestingly, firms which are headquartered close to their CEOs' birthplaces pollute less even though the environmental impact is geographically spread out across different facilities.

Our study contributes to a growing interdisciplinary body of literature on the behavioral determinants of environmental decision-making, specifically for top managers, by providing empirical evidence of ecological embeddedness and applying insights from environmental psychology to the corporate context. To this end, our study relies heavily on the Upper Echelons Theory (UET), which posits that corporate decisions are influenced by a company's top managers (Hambrick, 2007; Hambrick and Mason, 1984). By showing that corporate outcomes are strongly associated with CEO-level variables, our study contributes further empirical support for UET in the strategic management literature. Specifically, our results suggest that place attachment matters for corporate environmental decisions affecting both the place of production and the place of control. Second, our study contributes to a proliferating literature on place attachment as a moderator of behavior. Scannell and Gifford (2010) propose to organizing the inquiry into factors related to aspects concerning the person, the psychology, and the place itself. While much research has focused on the personal aspect of this tripartite framework, our investigation is more concerned with the nexus of psychology and place. Acknowledging the geographical separation between the place of control and the place of production for modern corporations and HQs and production facilities, our results reveal novel insights into the relative importance of "place identity" versus "place dependence".

Background and hypotheses

CEO attributes as predictors of corporate outcomes

UET, as proposed by Hambrick and Mason (1984) and later expanded by Hambrick (2007), posits that an organization's decisions and behaviors are strongly influenced by the individual characteristics, skills, and values of its top executives, particularly those at the highest echelons of management. This theory suggests that the cognitive and psychological makeup of top executives plays a critical role in shaping the direction and outcomes of the organization (Hambrick, 2007; Hambrick and Mason, 1984).

Empirical evidence supports the tenets of UET, indicating that managerial attributes and preferences significantly account for variations in corporate policies (Bamber et al., 2010; Bertrand and Schoar, 2003; Bromiley and Rau, 2016; Graham et al., 2012). Specifically, the characteristics and values of CEOs have been shown to impact various aspects of corporate behavior, including environmental, social, and governance (ESG) policies (Chin et al., 2013; Hegde and Mishra, 2019; Huang, 2013; Lewis et al., 2014; Oh et al., 2016). With respect to environmental outcomes, Szymczak et al. (2022) find that biographical exposure to natural hazards during CEOs' early lives is associated with more climate-friendly decisions during their tenure, demonstrating that psychological dynamics affecting CEOs are likely to affect corporate environmental outcomes.

In essence, UET underscores the pivotal role of individual psychological dynamics in driving organizational decisions. It emphasizes that organizational behavior is not merely a result of abstract corporate structures or external market forces but is deeply intertwined with the mindsets and characteristics of its top leadership. This perspective underscores the need to consider the human dimension, bridging the realms of managerial and psychological literature, to comprehensively understand and predict organizational outcomes.

The concept of embeddedness

Embedded decision-making

The concept of embeddedness was coined by Polanyi (1944) who argued that an economy cannot be disconnected from the social world in which it is embedded. Thus, businesses must be understood as being part of society. Since the 1980s, there has been a notable increase in the number of studies focusing on the social mechanisms through which economic actions take place and business outcomes are achieved (e.g., Dacin et al., 1999; Granovetter, 1985; Hernandez, 2014; Rao et al., 2000; Uzzi, 1997). Granovetter (1985: p. 487) further developed the concept which led to interpretations of economic action as "embedded in concrete, ongoing systems of social relations". In line with this expansion of the concept, literature in sociology, organizational theory, and management sciences uses embeddedness to refer to the contextualization of economic and organizational activity in wider social structures and surrounding ecosystems (e.g., Dacin et al., 1999; Jennings and Zandbergen, 1995; Powell, 1996; Uzzi, 1997).

The concept of embeddedness has gained attention within the field of management over the past few decades as organizations are increasingly recognized as being interconnected and interdependent within their environments (Hoffman, 1999; Hoffman and Jennings, 2015). It is increasingly understood that managers and other corporate decision-makers, as well as the companies for which they work, are tied to society through networks of relationships, which enable or constrain particular actions (Boons and Howard-Grenville, 2009), and that companies depend on resources provided by the natural environment. This perspective highlights the need for organizations to consider and address the potential ecological and social impacts of their operations (Banerjee, 2003; Freeman, 2010).

Emphasizing the ecological dimension, Whiteman and Cooper (2000) define the construct of ecological embeddedness, which refers to “the degree to which a manager is rooted in the land” (ibid.: p. 1267). Drawing on their ethnographic study of a Canadian beaver trapper, the authors propose that “to be ecologically embedded as a manager is to personally identify with the land, to adhere to beliefs of ecological respect, reciprocity, and care-taking, to actively gather ecological information, and to be physically located in the ecosystem”. Hence, they argue that managers who personally identify with an ecosystem are more committed to sustainable practices within that ecosystem than those who have no personal connection with the ecosystem. This is because proximity to and direct dependence on a local resource base enable managers to identify and discard practices that are clearly unsustainable (Folke et al., 2007). Therefore, a manager’s level of ecological embeddedness may affect their commitment to, and practice of, sustainability (Whiteman and Cooper, 2000). On the other hand, there are managers who are ecologically “disembedded”, who have no detailed knowledge of, or experience with, a specific land’s ecosystem (ibid.). This is when spatial mismatches occur because the boundaries of management do not coincide with the boundaries of the ecological entity (Folke et al., 2007). This mismatch between human responsibility and natural interactions means that the people who benefit from environmental exploitation are typically different from those who pay the costs, which could lead to unsustainable practices (Lee, 1993). Hence, ecological embeddedness may be a key factor in terms of shaping sustainable corporate behavior (Whiteman and Cooper, 2000).

The ambiguity of place in modern corporations

The concept of ecological embeddedness resonates with Edward Relph’s seminal contribution in his book on Place and Placelessness (Relph, 1976). In a recent reprint of his book, Relph argues that “sense of place has the potential to serve as a pragmatic foundation for addressing the profound local and global challenges, such as climate change and economic disparity, that are emerging in the present century" (Relph, 2008: p. 8). This implies that the placelessness of modern corporations may be a fundamental reason for the prevalence of unsustainable corporate behaviors.

Notably, the notion of "place" with respect to corporations has evolved significantly, reflecting the complex dynamics of globalization, technology, and corporate structure. Traditionally, corporations were often closely tied to a specific physical location, which encompassed both the place of control (typically the HQ) and the place of production (factories, offices, and operational facilities). As modern corporations have expanded and diversified, they are often characterized by a separation of the place of control from the place of production. This separation is exemplified by multinational corporations that have diversified their operations across multiple countries and regions, often centralizing their decision-making at a distant HQ (Meyer et al., 2011). As a result, the ecological footprint of many corporations extends far beyond their HQs or their primary production sites.

The separation of the place of control from the place of production has important implications for applying the concept of ecological embeddedness. Specifically, if the notion of place is ambiguous because a firm has multiple places and therefore operates in many ecosystems, it is unclear how to operationalize ecological embeddedness. Generally, the dimensions of ecological embeddedness outlined by Whiteman and Cooper (2000) require a definition of "place" including its scope. For instance, assessing whether a manager identifies with the "land" is feasible only if one clarifies which "land" a manager is supposed to identify with in order for ecological embeddedness to occur. Is it the "land" where the corporate HQ is situated or the "land" where corporate productions sites are – and if the latter, which production sites? And in terms of scope, should the "place" be at the level of the county, the country, or the ecosystem (forest, desert, etc.)? Similarly, it is unclear whether a manager's physical presence at corporate HQ justifies the notion of ecological embeddedness or whether managers must be able to experience the impacts of their decisions, such as polluted air, firsthand.

Personal identification with the land

According to Whiteman and Cooper (2000), an important component of ecological embeddedness is that managers personally identify personally with the land. This aspect resonates well with a lively strand of literature in environmental psychology that addresses the importance of attachment to a place as a moderator of behavior (Lewicka, 2011). Within this literature, the extent to which people incorporate a physical place into their self-identify is considered an important dimension (Proshansky, 1978). A strong "place identity" indicates that the place is integral to one's sense of self. Hence, impacts to the place will be projected onto the self, and these impacts will thus be taken personally. With respect to environmental decisions, this implies an inherent willingness to protect the environment that one identifies with from harm.

But what makes a person identify with a place? Recently, CEO locality has emerged as a new concept in the empirical literature. In this vein, a small but growing number of studies argues that CEOs' personal ties to a place or a region are an important determinant of their professional decisions (e.g., Bolor-Erdene et al., 2023; Chang et al., 2022; Fullilove, 1996; Kahn and Henderson, 1992; Lai et al., 2020; Li et al., 2021; Wu, 2008; Yonker, 2017). This strand of research suggests that CEO locality can have a tangible impact on various aspects of corporate decision-making (Kahn and Henderson, 1992). On the one hand, a CEO with strong ties to their local community might be more attuned to the needs and expectations of local stakeholders, leading to enhanced stakeholder engagement and trust (Wu, 2008). Additionally, a CEO with a deep emotional attachment to their hometown might exhibit a heightened commitment to long-term sustainable practices, driven by a desire to safeguard their local legacy (Fullilove, 1996; Mesch, 1996). On the other hand, CEOs who shares a geographic origin with the company's operational location might have an innate understanding of the local market dynamics, regulatory landscape, and social context (Yonker, 2017). This understanding can lead to more informed strategic choices that resonate with local stakeholders. Local CEOs, drawing on their superior understanding of local dynamics, might be better equipped to balance short-term financial goals with the long-term interests of the firm. This alignment can potentially manifest in diverse ways, from investment decisions to environmental strategies (Bolor-Erdene et al., 2023; Chang et al., 2022; Li et al., 2021).

While most studies on CEO locality use HQs as their point of reference, the possible adverse impacts of industrial releases materialize close to where pollutants are being emitted, i.e., facilities. Hence, when assessing the behavioral impact of personal identification with a place, it appears more plausible to define "place" in terms of facility locations rather than HQ locations. Analogously, if CEOs care most about the people and the natural environment near their birthplaces, their focus will be on preventing harm, i.e., toxic pollution, in those locations, possibly at the expense of others. It follows that CEOs will be specifically motivated to mitigate adverse impacts on communities and ecosystems that originate from facilities close to their birthplaces.

HYPOTHESIS I (PLACE ATTACHMENT, FACILITY-LEVEL). Corporate pollution will be lower at facilities close to the birthplaces of the respective CEOs.

A plausible extension of this argument is that corporate managers will be more aware of adverse environmental impacts of the corporation the more facilities are located close to their birth places. Following this reasoning, there should be a inverse relationship between the number of facilities close to a manager's birth place and the amount of the toxic releases emitted by the respective firm. This is formulated in the following:

HYPOTHESIS II (PLACE ATTACHMENT, FIRM-LEVEL). Aggregate corporate pollution will be lower when more of the firm's facilities are located close to the birthplaces of the respective CEOs.

While the most important physical impacts materialize close to facility locations, reputation effects are likely to spill over to corporate HQ locations since local media typically reports on businesses resident in their catchment areas (Zavyalova et al., 2012). Local media will incorporate any positive or negative news reports about the environmental conduct of the businesses they come across within the context of their research. Since our sample only covers facilities and firms located in the U.S., there are no language barriers that could prevent news reports from other domestic regions from being found or incorporated into broader media coverage. Recent evidence provides convincing support for the moderating role of media attention in corporate pollution behavior (Jiang and Kong, 2023). Given the pivotal role of CEOs in a firm, positive or negative news about the firm's conduct could be attributed to them personally, which could then have possible repercussions for their private lives. Therefore, concerns about the firm's image and reputation will be a particularly powerful correctional force for CEOs who are local to corporate HQ locations.

HYPOTHESIS III (IMAGE CONCERNS, FIRM-LEVEL). Aggregate corporate pollution will be lower for firms whose CEOs were born close to the firm's HQ.

Physical presence in the land

In addition to "place identity" and "place belonging", the literature recognizes the importance of "place dependence", i.e., the degree to which individuals rely on a particular place to fulfill their needs (Relph, 1976). In the same vein, Whiteman and Cooper (2000) argue that this dependence motivates managers to learn about safeguarding environmental resources. Moreover, continuous interaction with the "land" enables experiential learning. In this context, Whiteman and Cooper (ibid.) argue that an important factor that gives rise to ecological embeddedness is a manager's physical presence in the land. On the other hand, when decision-makers are physically distant from the locations where production and resource extraction occur, there is a risk of ecological disconnection. Corporations may become detached from the environmental consequences of their operations, which could potentially lead to unsustainable practices and environmental degradation (Jorgenson and Clark, 2009).

While it is prohibitively difficult and unethical under most circumstances to track CEOs' whereabouts, their office locations arguably provide a reasonable indication of their usual place of residence. Specifically, in pre-Covid times, the timeframe considered in this study (1994–2018), it was generally assumed that CEOs resided in or near the location where they worked. Since the executive functions of a corporation are generally located at corporate HQ, from which management and key staff operate and over- see a firm's overall business activities, a CEO's usual place of residence is likely to be within a reasonable commuting distance of corporate HQ. Even if some CEOs travel frequently and do not establish their main residences within the area, most of the firm's key staff, as well as their families and friends, will live within a reasonable proximity of corporate HQ. Since the adverse impacts of pollutants on people and the natural environment manifest close to their origin, corporate pollution originating from facilities close to corporate HQ are likely to have direct effects on several key decision-makers and their loved ones. Moreover, these individuals will be able to observe the effects firsthand, possibly raising awareness for the need to mitigate corporate pollution.

HYPOTHESIS IV (PHYSICAL PRESENCE, FACILITY-LEVEL). Corporate pollution will be lower at facilities that are close to the firm's HQ.

Finally, the maxim "divide and conquer", which is commonly attributed to Philip II of Macedon, may hold insights for the governance of corporate pollution. Specifically, it appears reasonable to assume that reputation dynamics will be most powerful when the relevant stakeholders have a critical mass (e.g., Bratton, 2005). This suggests that stakeholder pressure will be strongest when the firm's operations are centralized rather than dispersed. If pressure from local stakeholders is the main disciplining force to curb corporate pollution, firms whose corporate pollution are dispersed across many small facilities rather than concentrated at fewer larger facilities will generally pollute more in the aggregate.

HYPOTHESIS V (PHYSICAL PRESENCE, FIRM-LEVEL). Aggregate corporate pollution will be lower at firms whose facilities are less geographically spread out.

Data and methodology

Sample description

The EPA compiles data from the TRI, which documents toxic chemical releases and pollution prevention efforts carried out by industrial and federal facilities across the United States. The inception of the TRI can be credited to the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, which mandates that certain companies must disclose their emissions of specified toxic substances to the EPA.

The TRI data set is open to the public and encompasses a wide spectrum of data on more than 30,000 chemicals and their usage across more than 20,000 facilities nationwide. This repository provides comprehensive information regarding the quantities of toxic chemicals released into the environment by these facilities. Additionally, it offers valuable insights into the methods employed for the management and disposal of these chemicals.

As a general guideline, chemicals reported in the TRI typically fall into categories that 1) induce cancer or other long-term adverse effects on human health, 2) result in significant immediate negative impacts on human health, or 3) lead to substantial environmental repercussions. For each chemical on the list, the EPA establishes a minimum threshold for reporting emissions. Consequently, any facility engaged in the manufacturing, processing, or utilization of TRI-listed chemicals with a total quantity of toxic chemical releases surpassing these predefined levels is obligated to submit an annual reporting form.

The mandatory reporting covers 29 industry sectors – though not all industry sectors are classified by a North American Industry Classification System (NAICS) code. Most of the manufacturing sectors, like Chemical Manufacturing and Food Manufacturing, were involved in the original 1986 plan, and another seven sector industries, such as Metal Mining and Electric Utilities, were added by the EPA in 1997.

Starting with the original TRI data set, we took several steps to prepare it for our analyses. First, we removed observations where key variables, such as company name or facility name, were marked as "N/A". This resulted in a data set that included 19,309 facility-year observations across all industries, and involved 2,003 unique facilities. Within this data set, we then identified 163 unique firms and gathered a total of 1,751 firm-year observations. [1]

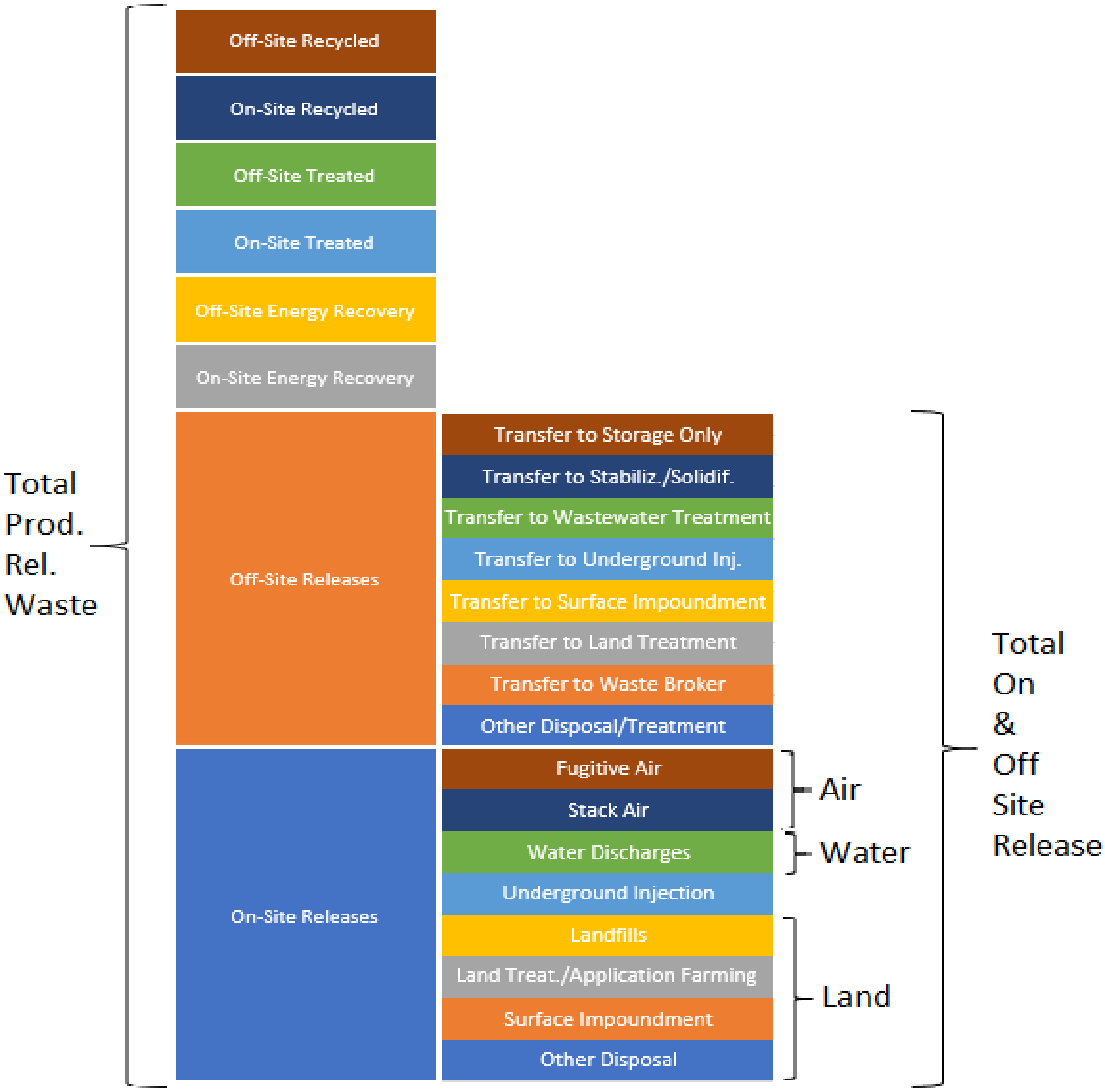
Methodology

Dependent variables

In our analysis, we employ various dependent variables based on the TRI data set, each focusing on different aspects of corporate pollution. Figure 1 illustrates the categorization of toxic releases within TRI, along with their corresponding subgroups. The variable "total production-related waste" encompasses all extant subcategories within the TRI data set. The variable "total on-site & off-site releases" aggregates all toxic chemical releases emitted at the facility by medium (air, water, land) as well as toxic chemical releases that are transferred to off-site locations for further processing. Our analysis is structured into two main parts: facility-level regressions and firm-level regressions. Therefore, we define our variables for both levels of aggregation.

[1] 1In the TRI data set, many observations of toxic chemical releases are below their respective reporting thresholds. In fact, 71% of our chemical release observations do not exceed their reporting threshold. This makes sense, however, since environmental managers spend a lot of time leading up to the 1st of July each year to determine the toxic chemical releases from their facility. Once the numbers are calculated and environmental managers find out that the threshold has not been exceeded, most of the work is already done. Filing and submitting the TRI Report to the EPA is then quickly done. It seems to be common that facilities emit chemicals that either do not exceed or barely exceed the reporting thresholds. The years missing from the data set seem to be those years in which companies do not file the TRI report after they discover that they have not exceeded the threshold. In such situations, their toxic chemical releases are low and consequently close to zero.

Figure 1: Approximate overview of TRI release & waste quantities



Facility-level variables. For our facility-level analyses, we include total production-related waste, total on-site and off-site toxic releases, and the fraction of on-site toxic releases in total toxic releases, as well as total toxic releases by medium. As illustrated in Figure 1, these variables encompass various subsets of toxic releases. Total production-related waste represents the broadest category and includes recycled, treated, and recovery measures, in addition to total on-site and off-site toxic releases (see Figure 1). Since the raw values for production-related waste and total on-site and off-site toxic releases reported in the TRI are impractically large, we transform all values by taking the natural logarithm. As a measure of actual releases emitted from a particular facility, we derive the ratio of on-site toxic releases and total on-site and off-site toxic releases (EPA, 2023a; EPA, 2023b). Hence, our main dependent variables are *Ln_prodwaste*, *Ln_total*, and *Rel_onsite*, where the prefix "Ln" indicates that we took the natural logarithm of those variables.

Additionally, we investigate on-site toxic releases by medium: air, water, and land. Again, we follow the same procedure and take the natural logarithm. These variables are denoted as *Ln_air*, *Ln_land*, and *Ln_water*.[2]

Firm-level variables. Since TRI data are reported at the facility level, we aggregate corporate pollution by parent company to conduct our firm-level analyses. For our first set of firm-level regressions, we define aggregate corporate pollution by summing up all facility-level on-site and off-site toxic releases and take the natural logarithm to reduce noise in the estimation, i.e., *Ln_total_releases*. Moreover, Hoffmann and Busch (2008) argue that emission intensities are more informative metrics of corporate environmental performance than raw emissions. Applying this reasoning to corporate pollution, we calculate two alternative metrics of corporate pollution intensity: (i) by dividing the natural logarithm of total firm-level toxic releases by the natural logarithm of total assets, we obtain the corporate pollution intensity relative to assets, i.e., *Rel_release_asset*; and (ii) by dividing the natural logarithm of total firm-level toxic releases by the natural logarithm of net income, we obtain the corporate pollution intensity relative to income, i.e., *Rel_release_income*. We use both measures to test the robustness of our results against different variable specifications.

In addition to those environmental performance metrics, we define two measures of financial performance – Return on Assets (*RoA*) and *Tobin's Q* – which are commonly used to assess a firm's profitability and growth prospects respectively.

Independent variables

Facility-level definition. Building on the concept of ecological embeddedness proposed by Whiteman and Cooper (2000), our regression analyses emphasize two key explanatory variables. First,

[2]Tables A1, A2, and A3 in the Appendix depict the top chemicals for each medium.

we define the binary variable $HQ \leq 100miles$ to indicate whether a facility is within a 100 mile radius of corporate HQ (1 if yes; 0 if no). This distance is determined through latitude and longitude coordinates. Since corporate HQ generally accommodate the executive functions of the corporation, including the offices of top executives as well as core strategic functions, the corporate HQ locations serve as a proxy for the usual place of residence for the corporation's top executives, including the CEO.

Second, we construct the binary variable $CEObirthplace \leq 100miles$, which indicates whether a facility is within 100 miles of the birthplace of the CEO from the parent company (1 if yes; 0 if no). This variable serves as an indicator of personal identification with a location. Our definition follows the definition used in previous studies on CEO locality. Moreover, we argue that there is a conceptual overlap between CEO locality and the identification dimension of ecological embeddedness.

Firm-level definition. Since the facility-level definitions cannot be used for firm-level analyses as such, we need to modify the definition of our key explanatory variables to transfer the essential information to the aggregate firm level. First, we define the variable *# facs close to BP*, which counts the number of facilities within a 100-mile radius of the CEO's birthplace.

Second, we define the variable *# facs*, which counts the number of all facilities as a measure of how concentrated corporate environmental impacts are. Moreover, this variable also serves as a control to counterbalance high values for our first explanatory variable, which results from a high number of facilities overall.

Third, we define a binary variable *Local CEO?*, indicating whether corporate HQ are within a 100-mile radius of the birthplace of the firm's CEO.

Control variables

Since the TRI only contains statistics relating to geographical locations and toxic releases of polluting facilities but not economic variables, such as production volumes or the number of employees, we are constrained in our analyses and cannot introduce additional independent variables for facility-level aspects. However, when conducting our firm-level regressions, we incorporate the natural logarithm of total assets – *Log(Assets)* – obtained from S&P Compustat, as a proxy for a company's size. The size of the firm is a crucial consideration, as it may significantly influence the number of facilities under its purview and the scale of their production activities. Therefore, factoring in firm size allows us to explore its potential impact on our findings. Moreover, we add *Leverage* as a proxy for corporate risk taking.

Estimation strategy

General. Our main objective is to evaluate the relationship between a CEO's ecological embeddedness and corporate pollution at the facility level as well as at the firm level. Thus, we structure our estimation approach into two main parts. The first part involves regressions on our facility-level variables, which provide us with more detailed insights into the effects directly at the facility level, whereas the second part estimates the relationships between our firm-level variables.

Facility-level regressions. With respect to our facility-level analyses, we estimate the relationship using ordinary least squares (OLS) panel regressions. To control for unobserved time-varying firm-level effects, such as variations in total production volumes, changes in ownership or corporate strategy, etc., we include combined firm-year fixed effects. In addition to time-varying firm-level effects, these combined fixed effects capture both time-varying macro or industry-level factors, such as the business cycle or economic shocks, as well as time-invariant firm-level characteristics. We argue that this approach is suitable to reduce the variation to facility-level variation. To cross-check the robustness of the estimated coefficients, we include OLS regressions with and without fixed effects for all dependent variables. Hence, the model is formulated as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \zeta_{\mathrm{yt}} + \varepsilon_{it}$$

where Y_{it} represents our facility-level dependent variables (*Ln_total, Ln_prod, Rel_offsite, Ln_air, Ln_water*, and *Ln_land*) for facility i and year t. Moreover, X_{1it} and X_{2it} are the independent variables (HQ $\leq$ 100 miles and CEO birthplace $\leq$ 100 miles, respectively) for firm i at time t. In addition to our explanatory variables, we include firm-year fixed effects captured by ζ_{yt} for firm y in year t, with ε as the error term.

Firm-level regressions. The second part of our regression analysis focuses on our firm-level variables. Analogous to our facility-level regressions, we use OLS panel regressions to estimate the relationship between firm-level dependent and independent variables. While S&P Compustat provides a richer array of time-varying firm-level controls, we include combined industry-fixed effects using the S&P industry classification. This approach allows us to control for unobserved industry-level effects, such as regulatory changes or demand shocks. Again, we provide the results with and without fixed effects to test the robustness of our estimated coefficients. Hence, we estimate the following regression model, categorized by different dependent variables and aggregations similar to the facility-level regressions:

$$Y_{yt} = \beta_0 + \beta_1 X_{1yt} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \zeta_{\text{st}} + \varepsilon_{it}$$

where Y_{yt} represents our firm-level dependent variables (*Ln_total_releases, Rel_release_asset, Rel_release_income, RoA*, and *Tobin's Q*) for firm y and year t. Moreover, X_{1it}, X_{2it}, and X_{3it} are the firm-level independent variables (*# facs close to BP, Local CEO?*, and *# facs* respectively) for firm y at time t. In addition to our explanatory variables, we include *Log(assets)* as a proxy (i.e., X_{4it}) for a firm's size and *Leverage* as a proxy (i.e., X_{5it}) for corporate risk taking. Moreover, we include industry-year fixed effects captured by ζ for an industry s in year t, with ε as the error term.

Empirical results

Descriptive statistics

In this section, we present descriptive statistics for key variables within our facility-level and firm-level data set, as displayed in Table 1 and Table 2.

For the facility level, our final data set comprises 19,309 facility-year observations covering 2,003 unique facilities, 163 unique firms, and 309 CEOs. Descriptive statistics for the variables of interests are reported in Table 1. The number of observations reported in the table refers to the number of non-null observations. The main dependent variables (*Ln_prodwaste, Ln_releases, Ln_air, Ln_land*, and *Ln_water*) are close to normally distributed. The distribution of *Rel_on_site* is polarized with clusters at 0 and 1 with a clear tendency towards the higher end. With respect to our explanatory variables, the sample statistics show that roughly 11% of our observations relate to facilities close to corporate HQ (217 unique facilities) and roughly 7% of observations to facilities close to CEO birthplaces (201 unique facilities).

Table 1: Sample statistics for the facility-level data set

	N	Mean	SD	Median	Min	Max
Ln_prodwaste	19309	10.98	3.62	11.31	-9.72	18.90
Ln_releases	18095	8.85	4.05	9.35	-11.70	18.26
Rel_on_site	18163	0.72	0.40	0.99	0.00	1.00
Ln_air	16403	8.06	4.25	8.72	-11.70	16.83
Ln_land	3291	9.90	4.48	11.18	-14.73	18.26
Ln_water	5116	6.30	3.83	6.45	-12.11	15.41
HQclose	19309	0.11	n/a	0.00	0.00	1.00
CEOclose	19309	0.07	n/a	0.00	0.00	1.00

Notes. This table reports sample statistics at the facility level. N reports the number of observations for the different variables. Moreover, different momenta of the distributions are disclosed (i.e, Mean, standard deviation (SD), Median, Minimum (Min), and Maximum (Max)).

For the firm level, our final data set comprises 1,751 firm-year observations covering 153 unique firms and 275 CEOs. As a result of the matching process, the firm-level data set covers slightly fewer firms than the facility-level data set (153 vs. 163) because we restricted our sample to firms for which we were able to obtain financial statistics from Compustat. The corresponding descriptive statistics are reported in Table 2.[3] Analogous to the sample statistics for our facility-level data set, the number of observations (N) indicates the number of non-null observations. Our main dependent variables (*Ln_total_releases, Rel_release_asset,* and *Rel_release_income*) are reasonably symmetric and follow a bell-shaped distribution. The number of facilities located close to the parent firm's CEO ranges between 0 and 18 with a median of 0, whereas the number of total

[3]Please see Appendix Table A4 for the correlation statistics for the firm level.

facilities per firm ranges from 1 to 112 with a median of 5. The descriptive statistics indicate that roughly 21% of our observations relate to firms within 100 miles of their CEO's birthplaces.

Table 2: Sample statistics for the firm-level data set

	N	Mean	SD	Median	Min	Max
Ln_total_releases	1751	12.31	3.23	12.58	-9.72	18.69
Rel_release_asset	1751	1.39	0.41	1.40	-1.43	3.87
Rel_release_income	1751	2.17	1.14	1.97	-1.96	23.84
# facs close to BP	1751	0.71	1.70	0.00	0.00	18.00
Local CEO?	1751	0.21	0.40	0.00	0.00	1.00
# facs	1751	10.17	12.71	5.00	1.00	112.00
Log(Assets)	1751	9.00	1.49	9.16	3.09	12.76
Leverage	1731	0.74	10.57	0.72	-317.50	161.74
RoA	1731	0.05	0.08	0.05	-0.75	0.99
Tobin's Q	1719	1.78	0.91	1.51	0.54	9.36

Notes. This table reports sample statistics at the firm level. N reports the number of observations for the different variables. Moreover, different momenta of the distributions are disclosed (i.e, Mean, standard deviation (SD), Median, Minimum (min), and Maximum (max)).

Facility-level regressions

Total corporate pollution

Table 3 presents the results of six regression analyses, investigating how spatial relationships between corporate production and corporate control, as an indicator of ecological embeddedness, are related to aggregate measures of facility-level pollution. The analysis encompasses three different dependent variables: *Ln_prodwaste* (Columns 1 and 2), *Ln_releases* (Columns 3 and 4), and *Rel_onsite* (Columns 5 and 6). To test the robustness of our estimates, firm-year fixed effects are incorporated into every second model (Columns 2, 4, and 6).

In terms of specific findings, the coefficient estimates for the independent variables are noteworthy. For facilities close to corporate HQ, the coefficients are positive and statistically significant for all models except for Model 6. This implies that the geographical proximity of facilities to corporate HQ is associated with higher levels of total production-related waste (*Ln_prodwaste*) and total corporate pollution (*Ln_releases*). With respect to the relative share of corporate pollution processed on-site, the coefficient is positive and significant in the model without fixed effects

Table 3: Facility-level panel regressions on total, production, and rel. on-site corporate pollution

	Dependent variable					
	Ln_prodwaste		Ln_releases		Rel_on_site	
	(1)	(2)	(3)	(4)	(5)	(6)
HQ $\leq$ 100 miles	1.232***	0.390***	1.654***	0.585***	0.030***	0.016
	(0.088)	(0.092)	(0.102)	(0.100)	(0.010)	(0.011)
CEO birthplace $\leq$ 100 miles	$-$0.669***	$-$0.277**	$-$0.923***	$-$0.432***	$-$0.030**	$-$0.038***
	(0.111)	(0.108)	(0.128)	(0.118)	(0.013)	(0.013)
Constant	10.881***	11.725***	8.723***	10.030***	0.718***	0.784***
	(0.028)	(0.486)	(0.032)	(0.535)	(0.003)	(0.060)
Observations	19,309	19,309	18,095	18,095	18,163	18,163
Firm-year FE	No	Yes	No	Yes	No	Yes
R^2	0.010	0.400	0.014	0.470	0.001	0.321
Adjusted R^2	0.010	0.333	0.014	0.408	0.0005	0.242
F Statistic	97.210***	5.928***	131.562***	7.581***	5.195***	4.064***

Notes. This table reports firm-year fixed-effects regression results for the relation between two proxies for CEO's ecological embeddedness – *HQ $\leq$ 100 miles* and *CEO birthplace $\leq$ 100 miles* – and different dependent variables for corporate pollution. In Columns (1) and (2) the dependent variable is *Ln_prodwaste*, in Columns (3) and (4) it is *Ln_releases*, and in Columns (5) and (6) it is *Rel_onsite*. In addition, in every second model, i.e., Columns (2), (4), and (6), firm-year fixed effects are included in the models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

(Column 5) but insignificant when controlling for firm-year effects (Column 6).

Conversely, facilities located within 100 miles of the birthplace of their parent firm's CEO tend to emit lower levels of toxic pollution, as evidenced by statistically significant negative coefficients for the two dependent variables relating to absolute pollution: *Ln_prodwaste* (-0.669, -0.277) and *Ln_releases* (-0.923, -0.432). Moreover, facilities close to CEO birthplaces tend to rely more on off-site versus on-site processing, as indicated by negative and significant coefficients in models (5) and (6): *Rel_onsite* (-0.030, -0.038).

The inclusion of firm-year fixed effects in some models enhances the robustness of these findings. Furthermore, the F-statistics indicating the overall model significance is notably significant for all models, reaffirming the validity of the regression models.

In summary, the results in Table 3 provide compelling evidence of the association between important dimensions of CEO ecological embeddedness, as measured by the spatial relationship of facilities with corporate HQ and CEO birthplaces, and various measures of industrial pollution. Specifically, corporate pollution tend to be lower at facilities close to the birthplaces of the respective CEOs. Moreover, facilities close to the CEOs' birthplaces tend to process a smaller fraction of waste on-site. Thus, our results support Hypothesis HI (PLACE ATTACHMENT, FACILITY-LEVEL). Surprisingly, corporate pollution tend to be higher at facilities that are close to their parent firm's HQ. Hence, we reject Hypothesis HIV (PHYSICAL PRESENCE, FACILITY-LEVEL), and find the opposite relationship.

Corporate pollution by medium

Table 4 presents estimates for six regressions models, investigating the association between CEO ecological embeddedness and dependent variables concerning air, water, and land corporate pollution. The analysis encompasses three distinct dependent variables: *Ln_air* (Columns 1 and 2), *Ln_water* (Columns 3 and 4), and *Ln_land* (Columns 5 and 6). Firm-year fixed effects are incorporated into every second model (Columns 2, 4, and 6), mirroring the approach in Table 3.

Facilities within 100 miles of corporate HQ tend to report higher levels of corporate pollution across all three dependent variables. In contrast to our hypothesis, the positive relationship implies that geographical proximity of production sites to corporate control functions is associated with higher not lower levels of air, water, and land corporate pollution.

In contrast, facilities that are within 100 miles of the birthplaces of their parent firm's CEOs display significantly negative coefficients for two dependent variables: *Ln_air* (-0.967, -0.483) and *Ln_water* (-1.315, -1.074). This indicates that facilities in close proximity to CEOs' birthplaces tend to report lower levels of air and water corporate pollution. We find no significant relationship between birthplace proximity and land corporate pollution.

The inclusion of firm-year fixed effects affirms the reliability of these findings. Furthermore, the F-statistics confirm the overall significance of the regression models, underscoring the validity

Table 4: Facility-level panel regressions on air, water, and land corporate pollution

	Dependent variable					
	Ln_air		Ln_land		Ln_water	
	(1)	(2)	(3)	(4)	(5)	(6)
HQ $\leq$ 100 miles	1.572***	0.559***	1.575***	1.508***	1.445***	0.506***
	(0.111)	(0.106)	(0.209)	(0.214)	(0.155)	(0.172)
CEO birthplace $\leq$ 100 miles	−0.967***	−0.483***	0.049	0.244	−1.315***	−1.074***
	(0.141)	(0.128)	(0.342)	(0.416)	(0.215)	(0.246)
Constant	7.938***	9.654***	9.610***	8.732***	6.161***	4.792***
	(0.035)	(0.577)	(0.086)	(1.587)	(0.059)	(1.383)
Observations	16,403	16,403	3,291	3,291	5,116	5,116
Firm-year FE	No	Yes	No	Yes	No	Yes
R^2	0.012	0.510	0.019	0.627	0.018	0.494
Adjusted R^2	0.012	0.448	0.018	0.497	0.017	0.348
F Statistic	100.217***	8.256***	31.692***	4.822***	46.463***	3.395***

Notes. This table reports firm-year fixed-effects regression results for the relation between two proxies for CEO's ecological embeddedness – *HQ* $\leq$ *100 miles* and *CEO birthplace* $\leq$ *100 miles* – and different dependent variables for corporate pollution. In Columns (1) and (2) the dependent variable is *Ln_air*, in Columns (3) and (4) it is *Ln_water*, and in Columns (5) and (6) it is *Ln_land*. In addition, in every second model, i.e., Columns (2), (4), and (6), firm-year fixed effects are included in the models. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

of the results.

In summary, Table 4 provides robust evidence of the connection between CEO ecological embeddedness, as indicated by *HQ* $\leq$ *100 miles* and *CEO birthplace* $\leq$ *100 miles*, and corporate pollution by air, water, and land. Corroborating the results for aggregate pollution, we find that corporate pollution across all mediums tend to be higher at facilities close to corporate HQ. Similar to our previous regression results, our results contradict Hypothesis HIV (PHYSICAL PRESENCE, FACILITY-LEVEL). Moreover, we find that facility-level corporate pollution by air and water are lower at facilities within 100 miles of their CEO's birthplaces. Hence, our empirical support for Hypothesis HI (PLACE ATTACHMENT, FACILITY-LEVEL) is robust to varying subdimensions of industrial pollution.

Firm-level regressions

Aggregate releases

Table 5: Firm-level panel regressions on total corporate pollution and intensities

	Dependent variable					
	Ln_total_releases		Rel_release_asset		Rel_release_income	
	(1)	(2)	(3)	(4)	(5)	(6)
# facs close to BP	0.068**	0.002	0.010**	0.003	0.007	−0.039
	(0.034)	(0.063)	(0.004)	(0.007)	(0.013)	(0.033)
Local CEO?	−0.378**	−0.590***	−0.051**	−0.089***	−0.041	−0.095
	(0.179)	(0.204)	(0.021)	(0.026)	(0.067)	(0.107)
# facs	0.089***	0.075***	0.010***	0.008***	0.008***	0.007**
	(0.006)	(0.010)	(0.001)	(0.001)	(0.002)	(0.003)
Log(Assets)	0.370***	0.417***	−0.130***	−0.135***	0.120***	0.154***
	(0.054)	(0.075)	(0.008)	(0.011)	(0.018)	(0.029)
Leverage		−0.006*		−0.001		−0.001
		(0.004)		(0.0004)		(0.002)
Constant	8.108***	3.886***	2.471***	1.891***	1.012***	0.356*
	(0.482)	(0.476)	(0.080)	(0.068)	(0.146)	(0.185)
Observations	1,751	1,731	1,751	1,731	1,751	1,731
Industry-year FE	No	Yes	No	Yes	No	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.192	0.675	0.253	0.706	0.040	0.360
Adjusted R^2	0.190	0.466	0.251	0.517	0.038	−0.051
F Statistic	103.399***	3.226***	147.834***	3.738***	18.358***	0.876

Notes. This table presents industry-year fixed-effects regression results, examining the relationship between various independent variables and different dependent variables related to corporate pollution. In Columns (1) and (2) the dependent variable is *Ln_total_releases*, in Columns (3) and (4) it is *Rel_release_asset*, and in Columns (5) and (6), it is *Rel_release_income*. In addition, in every second model, i.e., Columns (2), (4), and (6) industry-year fixed effects and *Leverage* are included in the models. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

The regression results presented in Table 5 offer valuable insights into the intricate relationship between a CEO's ecological embeddedness and corporate pollution in the context of firms. These regressions aim to explore the potential influence of various dimensions of a CEO's ecological embeddedness on different measures of corporate pollution, while also considering the impact of control variables.

In Columns (1) and (2), the dependent variable of interest is the natural logarithm of total corporate pollution at the firm level, i.e., *Ln_total_releases*. The coefficient for *# facs close to BP* in the first respective model, i.e., Column (1), is positive and statistically significant at the 5% level. This suggests that CEOs with a higher number of facilities located in proximity to their birthplace tend to manage firms with higher levels of total corporate pollution. However, when including *Leverage* as a control variable the statistical power vanishes. Furthermore, the variable *Local CEO?* indicates whether corporate HQ is within 100 miles of the CEO's birthplace. The coefficient for this variable is negative and statistically significant in Columns (1) and (2), implying that firms with CEOs who are based locally tend to exhibit lower levels of total toxic corporate pollution. Additionally, the variable *# facs* is included, and its coefficient is positive and statistically significant at the 1% level in both Columns (1) and (2). This indicates that having a greater number of facilities is associated with higher levels of total toxic corporate pollution.

Columns (3) and (4) introduce a different perspective by considering the ratio of the natural logarithm of total corporate pollution to the natural logarithm of assets (*Rel_release_asset*). In Columns (3), the number of facilities close to a CEO's birthplace (*# facs close to BP*) remains positively related to the ratio of total releases to assets and is statistically significant at the 5% level. This suggests that CEOs with more facilities near their birthplace tend to manage firms with a higher ratio of total corporate pollution to assets. Moreover, the coefficient for the dummy variable for *Local CEO?* maintains its negative association with corporate pollution, and its coefficient is statistically significant in Columns (3) and (4), indicating that firms with CEOs based locally tend to have a lower ratio of total corporate pollution to assets. Additionally, the coefficient for the number of facilities *# facs* is again positively related to the corporate pollution ratio, and it is statistically significant at the 1% level in both Columns (3) and (4).

In Columns (5) and (6), the focus shifts to pollution intensity based on net income (log pollution/log income): *Rel_release_income*. In Columns (5) and (6), we find no significant relationship between the coefficient for *# facs close to BP* and the pollution intensity. In the same vein, the results show no significant relationship between *Local CEO?* and pollution intensity. The coefficient for the number of facilities *# facs* indicates a positive relationship with pollution intensity in both Columns (5) and (6) and is statistically significant.

Those regression results collectively highlight the importance of CEO's proximity to facilities and corporate HQs in influencing various measures of corporate pollution. Firms with relatively more facilities close to their CEOs' birthplaces tend to have higher corporate pollution, as indicated by higher levels and intensities of corporate pollution with the notable exception of the pollution intensity based on net income. Hence, we reject Hypothesis HII (PLACE ATTACHMENT, FIRM-LEVEL).

In contrast to the results observed at the facility level, we find that firms whose corporate HQs are located close to their CEOs' birthplaces (*Local CEO?*) report lower corporate pollution in total both in absolute terms and for the ratio of total corporate pollution to assets. Therefore, our results support Hypothesis HIII (IMAGE CONCERNS, FIRM-LEVEL).

In line with our reasoning, we find that firms whose operations are more dispersed, as indicated by a higher number of facilities, tend to report higher total corporate pollution for most indicators. Thus, we find some support for Hypothesis HV (PHYSICAL PRESENCE, FIRM-LEVEL).

Financial performance

To assess the financial implications of the hypothesized dynamics, we supplement our analyses with explorative results on the impact of our explanatory variables on common measures of corporate financial performance.

Table 6 presents the results of six regression models that analyze the relationship between CEO's ecological embeddedness and two key financial performance measures: *RoA* and *Tobin's Q*. These models aim to investigate whether CEO characteristics and ecological embeddedness play a role in explaining variations in these financial performance metrics, while controlling for

Table 6: Firm-level panel regressions on corporate financial performance

	Dependent variable					
	RoA			Tobin's Q		
	(1)	(2)	(3)	(4)	(5)	(6)
# facs close to BP	−0.003***	−0.004***	−0.006***	−0.055***	−0.055***	−0.077***
	(0.001)	(0.001)	(0.002)	(0.011)	(0.012)	(0.015)
Local CEO?	0.013***	0.014***	0.017***	0.133**	0.134**	0.252***
	(0.005)	(0.005)	(0.006)	(0.066)	(0.066)	(0.059)
# facs	0.0004***	0.0003**	0.001***	−0.001	0.00002	0.008***
	(0.0001)	(0.0001)	(0.0003)	(0.001)	(0.001)	(0.002)
Log(Assets)		0.002	−0.001		−0.020	−0.036**
		(0.002)	(0.003)		(0.015)	(0.018)
Leverage		−0.0004***	−0.0004***		−0.004***	−0.001
		(0.0001)	(0.0001)		(0.001)	(0.001)
Constant	0.043***	0.022	0.066***	1.797***	1.971***	1.591***
	(0.003)	(0.018)	(0.017)	(0.030)	(0.131)	(0.114)
Observations	1,731	1,731	1,731	1,719	1,719	1,719
Industry-year FE	No	No	Yes	No	No	Yes
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.006	0.010	0.499	0.010	0.014	0.763
Adjusted R^2	0.004	0.008	0.176	0.009	0.011	0.610
F Statistic	3.605**	3.625***	1.548***	6.050***	4.902***	4.967***

Notes. This table presents industry-year fixed-effects regression results, examining the relationship between various independent variables and different dependent variables related to corporate pollution. In Columns (1), (2), and (3) the dependent variable is *ROA*, while in Columns (3), (4) and (5), it is *Tobin's Q*. In every third model, i.e., Columns (3) and (6), industry-year fixed effects are included in the models. Additionally, Columns (2), (3), (5), and (6) include *Log(Assets)* and *Leverage* as additional control variables. Standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10% probability levels, respectively. Standard errors are reported in parentheses.

additional factors.

Columns (1), (2), and (3) focus on *RoA*, an important indicator of a firm's profitability. The coefficients for *# facs close to BP* demonstrate a statistically significant negative relationship with *RoA* at the 1% significance level across all models concerning *RoA*. This indicates that firms with a higher number of facilities located in proximity to their CEO's birthplace tend to be less profitable than those with relatively fewer facilities close to the CEO's birthplace.

On the contrary, the coefficients for *Local CEO?* are positive and statistically significant at the 1% level for all models. This suggests that firms led by CEOs born close to corporate HQ tend to be more profitable than those run by non-local CEOs. The number of facilities *# facs* has a positive relationship with *RoA* for all respective models (Columns (1) to (3)), indicating that firms with more dispersed operations tend to be more profitable.

Columns (4), (5), and (6) shift the focus to *Tobin's Q*, a metric reflecting a firm's market value which is also used as a proxy for growth prospects. Here, *# facs close to BP* exhibits a statistically significant negative relationship with the dependent variable, which is robust to different model specifications. This implies that firms with more facilities near their CEOs' birthplaces tend to have a lower Tobin's Q, indicating a slightly lower valuation by the market or slimmer growth prospects. Vice versa, the coefficients for *Local CEO?* are positive (0.133 - 0.252) and significant at the 1 to 5% levels depending on the model specification. This positive relationship indicates that firms whose CEOs were born close to corporate HQ are regarded by the market as having higher growth prospects, and thus a higher market valuation, ceteris paribus. Moreover, we find a positive relationship between dispersion *# facs* and *Tobin's Q* in Model (6), whereas the respective coefficient is insignificant in Models (4) and (5).

In summary, these regression results provide insights into the intricate relationship between a CEO's ecological embeddedness and financial performance measures, *RoA*, and *Tobin's Q*. Our results show that firms with more facilities close to their CEOs' birthplaces appear to be less profitable, as indicated by lower *RoA*, and less favorably assessed by the market, as indicated by lower *Tobin's Q*. Interestingly, the results suggest that firms managed by CEOs local to corporate

HQ, i.e., CEOs born close the respective firms' HQ, are more profitable and are assessed more favorably by the market relative to firms managed by non-local CEOs.

Discussion and conclusion

The findings of this study provide valuable insights into how spatial relationships between the place of control and the place of production in modern corporations affect corporate pollution at the facility level at the firm level.

In line with behavioral predictions derived from the theory of place attachment, which constitutes an important dimension of Whiteman and Cooper (2000)'s definition of ecological embeddedness, we find that corporate pollution are lower at facilities and firms close to the birthplaces of their CEOs. The negative relationship discovered between CEO birthplace proximity and facility-level corporate pollution suggests that CEOs care about their "nest" and selectively mitigate pollution affecting the communities close to their birthplaces. This finding underscores the role of personal connections and ecological embeddedness in shaping corporate environmental decisions, highlighting the importance of CEOs' attachment to their places of origin.

One intriguing revelation from our study is the positive relationship observed between the geographical proximity of facilities to corporate HQ and facility-level corporate pollution. This suggests that when corporate control centers are in close physical proximity to operational facilities, there is a tendency for higher corporate pollution levels at those facilities. This outcome contradicts the concept of ecological embeddedness, questioning the positive effect of the CEO's physical presence and engagement with the operational environment on environmental outcomes in modern corporations. One possible explanation for this counterintuitive finding may be that strategically important (and possibly larger) facilities are located close to corporate HQ for historical or operational reasons. Moreover, CEOs may not spend much time in the natural environment due to long working hours and an efficiently knit schedule. Further research is required to investigate this dynamic in more detail.

A surprising reversal of the relationships occurs at the firm level. Aggregate corporate pollution is lower in firms where corporate HQs are close to CEOs' birthplaces but higher the more facilities are located close to the CEOs' birthplaces. This observation prompts a nuanced discussion of ecological and social embeddedness as a disciplining force concerning corporate pollution. If reductions in facility-level pollution are driven by factors relating to CEO embeddedness, such as personal identification with a place or social ties to affected communities, reductions at some facilities may be achieved at the expense of other facilities located in places where CEOs lack attachments. This highlights the complexity of ecological and social embeddedness within modern corporations and emphasizes the need for a holistic consideration of facilities as part of a larger puzzle. Moreover, our analysis of the financial implications suggests that CEO locality can be both a source of agency costs as well as a driver of better management: while CEOs born close to facility locations tend to preside over firms with higher aggregate pollution, lower profitability, and less favorable market evaluations, the relationships are reversed for CEOs born close to their firms' HQ.

Our study makes several contributions to the literature. First, our study contributes to the empirical validation of UET by demonstrating a robust association between CEO-level variables and corporate environmental outcomes. In doing so, we emphasize the pivotal role played by CEOs in shaping corporate environmental strategies and decisions. Moreover, our study adds new insights to our understanding of place attachment as a moderator of (pro)environmental behavior. One of the distinguishing aspects of our research is the recognition of the geographical separation inherent in modern corporations, with distinct locations for corporate HQ and production facilities. Specifically, our results shed new light on the relative significance of place identity versus place dependence in influencing corporate environmental decision-making. This distinction underscores the complex dynamics between the attachment to the place of control and the place of production within contemporary corporate structures. Additionally, it offers important insights into the validity of the conceptualization of ecological embeddedness proposed by Whiteman and Cooper (2000). While this concept is intuitively appealing, our findings highlight the need for further exploration of the dimensions that contribute to ecological embeddedness and their impact on corporate environmental outcomes.

While this research significantly advances our understanding of the factors shaping corporate pollution, it is not without limitations. The definition of explanatory variables, particularly the use of CEO birthplace proximity as a measure of ecological embeddedness, represents an imperfect approximation of CEOs' identification with the ecosystems in which their firms operate. First, we rely on birthplaces as proxies for CEOs' personal identification with local communities and ecosystems. An implicit assumption of this approach is that birthplaces provide an indication of the CEOs' whereabouts during their childhood and early adolescence, since the quality and quantity of social ties will depend on actual time spent *living* in those communities. Although it is possible that CEOs moved away from their birthplaces during their early lives, recent literature on CEO locality suggests that CEOs remain closely attached to their birthplaces even in their adult lives (e.g., Lai et al., 2020). Moreover, Bernile et al. (2017) report that many CEOs obtain their first social security numbers close to their birthplaces. Furthermore, we rely on corporate HQ as a proxy for the usual place of residence of the firms' CEOs. Arguably, some CEOs may have their main offices at local offices instead of corporate HQ, may work remotely, or may travel between locations. In theory, it is possible to contact companies to inquire about the exact locations of corporate executive offices. However, practical considerations and operational risk concerns within firms might limit the availability of accurate disclosures of CEO locations. Future research could benefit from more precise measures and a deeper exploration of the dimensions of ecological embeddedness that contribute to environmental decision-making.

In conclusion, our study illuminates the intricate behavioral dynamics associated with the separation of the place of control from the place of production and corporate pollution within the context of modern corporations. The empirical results provide nuanced insights into how CEO-level dynamics, geographical proximity, and reputation dynamics interact to influence environmental decisions, underscoring the multifaceted nature of corporate environmental behavior. It is our hope that this research will stimulate further investigation into the nuanced dynamics of ecological embeddedness and corporate environmental decisions, contributing to the ongoing discourse on sustainable business practices.

References

Agency, U. S. E. P. (2023a). *Tri explorer - release reports metadata*. Retrieved March 15, 2023, from https://enviro.epa.gov/triexplorer/trimetadata.showgroup?p_showtype=onoffsite

Agency, U. S. E. P. (2023b). *Tri explorer - waste quantity report metadata*. Retrieved March 15, 2023, from https://staging.edap-cluster.com/triexplorer/trimetadata.showgroup?p_showtype=wastequantity

Bamber, L. S., Jiang, J., & Wang, I. Y. (2010). What's my style? The influence of top managers on voluntary corporate financial disclosure. *The Accounting Review*, *85*(4), 1131–1162.

Banerjee, S. B. (2003). Who sustains whose development? sustainable development and the reinvention of nature. *Organization studies*, *24*(1), 143–180.

Bernile, G., Bhagwat, V., & Rau, P. R. (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and ceo behavior. *The Journal of Finance*, *72*(1), 167–206.

Bertrand, M., & Schoar, A. (2003). Managing with style: The effect of managers on firm policies. *The Quarterly Journal of Economics*, *118*(4), 1169–1208.

Bolor-Erdene, B., Jung, K., Lee, W.-J., Park, S., & Sunwoo, H.-Y. (2023). Ceo locality and audit fees. *International Journal of Auditing*.

Boons, F., & Howard-Grenville, J. (2009). Introducing the social embeddedness of industrial ecology. In *The social embeddedness of industrial ecology*. Edward Elgar Publishing.

Bratton, K. A. (2005). Critical mass theory revisited: The behavior and success of token women in state legislatures. *Politics & Gender*, *1*(1), 97–125.

Bromiley, P., & Rau, D. (2016). Social, behavioral, and cognitive influences on upper echelons during strategy process: A literature review. *Journal of Management*, *42*(1), 174–202.

Chang, D., Chang, X., & Yan, W. (2022). Ceo locality and corporate social responsibility. *Available at SSRN 4275700*.

Chin, M., Hambrick, D. C., & Treviño, L. K. (2013). Political ideologies of ceos: The influence of executives' values on corporate social responsibility. *Administrative Science Quarterly*, *58*(2), 197–232.

Dacin, M. T., Ventresca, M. J., & Beal, B. D. (1999). The embeddedness of organizations: Dialogue & directions. *Journal of management*, *25*(3), 317–356.

Dana, J., Weber, R. A., & Kuang, J. X. (2007). Exploiting moral wiggle room: Experiments demonstrating an illusory preference for fairness. *Economic Theory*, *33*, 67–80.

Folke, C., Pritchard Jr, L., Berkes, F., Colding, J., & Svedin, U. (2007). The problem of fit between ecosystems and institutions: Ten years later. *Ecology and society*, *12*(1).

Freeman, R. E. (2010). *Strategic management: A stakeholder approach*. Cambridge university press.

Fuller, R., Landrigan, P. J., Balakrishnan, K., Bathan, G., Bose-O'Reilly, S., Brauer, M., Caravanos, J., Chiles, T., Cohen, A., Corra, L., et al. (2022). Pollution and health: A progress update. *The Lancet Planetary Health*, *6*(6), e535–e547.

Fullilove, M. T. (1996). Psychiatric implications of displacement: Contributions from the psychology of place. *American journal of psychiatry*, *153*, 12.

Graham, J. R., Li, S., & Qiu, J. (2012). Managerial attributes and executive compensation. *The Review of Financial Studies*, *25*(1), 144–186.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American journal of sociology*, *91*(3), 481–510.

Hambrick, D. C. (2007). Upper Echelons Theory: An Update. *Academy of Management Review*, *32*(2), 334–343.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193–206.

Hegde, S. P., & Mishra, D. R. (2019). Married CEOs and corporate social responsibility. *Journal of Corporate Finance*, *58*, 226–246.

Hernandez, E. (2014). Finding a home away from home: Effects of immigrants on firms' foreign location choice and performance. *Administrative Science Quarterly*, *59*(1), 73–108.

Hoffman, A. J. (1999). Institutional evolution and change: Environmentalism and the us chemical industry. *Academy of management journal*, *42*(4), 351–371.

Hoffman, A. J., & Jennings, P. D. (2015). Institutional theory and the natural environment: Research in (and on) the anthropocene. *Organization & Environment*, *28*(1), 8–31.

Hoffmann, V. H., & Busch, T. (2008). Corporate carbon performance indicators: Carbon intensity, dependency, exposure, and risk. *Journal of Industrial Ecology*, *12*(4), 505–520.

Huang, S. K. (2013). The impact of ceo characteristics on corporate sustainable development. *Corporate Social Responsibility and Environmental Management*, *20*(4), 234–244.

Jennings, P. D., & Zandbergen, P. A. (1995). Ecologically sustainable organizations: An institutional approach. *Academy of management review*, *20*(4), 1015–1052.

Jiang, J. X., & Kong, J. (2023). Green dies in darkness? environmental externalities of newspaper closures. *Review of Accounting Studies*, 1–36.

Jorgenson, A. K., & Clark, B. (2009). The economy, military, and ecologically unequal exchange relationships in comparative perspective: A panel study of the ecological footprints of nations, 1975—2000. *Social Problems*, *56*(4), 621–646.

Kahn, J. A., & Henderson, D. A. (1992). Location preferences of family firms: Strategic decision making or "home sweet home"? *Family Business Review*, *5*(3), 271–282.

Lai, S., Li, Z., & Yang, Y. G. (2020). East, west, home's best: Do local ceos behave less myopically? *The Accounting Review*, *95*(2), 227–255.

Lee, K. N. (1993). Greed, scale mismatch, and learning. *Ecological Applications*, 560–564.

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of environmental psychology*, *31*(3), 207–230.

Lewis, B. W., Walls, J. L., & Dowell, G. W. (2014). Difference in degrees: CEO characteristics and firm environmental disclosure. *Strategic Management Journal*, *35*(5), 712–722.

Li, W., Xu, Q., & Zhu, Q. (2021). Ceo hometown favoritism in corporate environmental policies. *Available at SSRN 3859116*.

Mesch, G. S. (1996). The effect of environmental concerns and governmental incentives on organized action in local areas. *Urban Affairs Review*, *31*(3), 346–366.

Meyer, K. E., Mudambi, R., & Narula, R. (2011). Multinational enterprises and local contexts: The opportunities and challenges of multiple embeddedness. *Journal of management studies*, *48*(2), 235–252.

Moran, D., & Kanemoto, K. (2016). Tracing global supply chains to air pollution hotspots. *Environmental Research Letters*, *11*(9), 094017.

Oh, W.-Y., Chang, Y. K., & Cheng, Z. (2016). When ceo career horizon problems matter for corporate social responsibility: The moderating roles of industry-level discretion and blockholder ownership. *Journal of Business Ethics*, *133*(2), 279–291.

Powell, W. W. (1996). On the nature of institutional embeddedness: Labels vs explanation. *Advances in strategic management*, *13*, 293–300.

Proshansky, H. M. (1978). The city and self-identity. *Environment and behavior*, *10*(2), 147–169.

Rao, H., Davis, G. F., & Ward, A. (2000). Embeddedness, social identity and mobility: Why firms leave the nasdaq and join the new york stock exchange. *Administrative Science Quarterly*, *45*(2), 268–292.

Relph, E. (1976). *Place and placelessness* (Vol. 67). Pion London.

Relph, E. (2008). *Place and placelessness*. Pion. https://books.google.de/books?id=WIPinAAACAAJ

Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology*, *30*(1), 1–10.

Szymczak, W., Wagner, S. A., & Busch, T. (2022). Do early-life extreme weather experiences of ceos affect corporate climate strategies?

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative science quarterly*, 35–67.

Weber, E. U. (2010). What shapes perceptions of climate change? *Wiley Interdisciplinary Reviews: Climate Change*, *1*(3), 332–342.

Whiteman, G., & Cooper, W. H. (2000). Ecological embeddedness. *Academy of management journal*, *43*(6), 1265–1282.

Wu, W.-p. (2008). Dimensions of social capital and firm competitiveness improvement: The mediating role of information sharing. *Journal of management studies*, *45*(1), 122–146.

Xu, Q., & Kim, T. (2022). Financial constraints and corporate environmental policies. *The Review of Financial Studies*, *35*(2), 576–635.

Yonker, S. E. (2017). Geography and the market for ceos. *Management Science*, *63*(3), 609–630.

Zavyalova, A., Pfarrer, M. D., Reger, R. K., & Shapiro, D. L. (2012). Managing the message: The effects of firm actions and industry spillovers on media coverage following wrongdoing. *Academy of Management journal*, *55*(5), 1079–1101.

A Appendix

Table A1: Top 10 Air corporate pollution

Chemical name	Pounds
HYDROCHLORIC ACID (1995 AND AFTER "ACID AEROSOLS" ONLY)	4101083376.29
SULFURIC ACID (1994 AND AFTER "ACID AEROSOLS" ONLY)	1061404503.71
AMMONIA	788830206.01
METHANOL	756977300.67
HYDROGEN FLUORIDE	466929565.26
TOLUENE	261144002.98
CERTAIN GLYCOL ETHERS	171113069.31
XYLENE (MIXED ISOMERS)	164197134.50
N-BUTYL ALCOHOL	118959606.72
N-HEXANE	104119925.44

*Notes.*This table reports the top 10 chemicals in our data set by total corporate pollution for air.

Table A2: Top 10 Water corporate pollution

Chemical name	Pounds
NITRATE COMPOUNDS	1109500005.00
MANGANESE COMPOUNDS	31859807.46
AMMONIA	21574827.80
METHANOL	20208797.72
SODIUM NITRITE	19802855.09
BARIUM COMPOUNDS	10016015.93
ZINC COMPOUNDS	6605723.87
ETHYLENE GLYCOL	5853732.32
COPPER COMPOUNDS	2584868.37
FORMIC ACID	2517340.20

Notes. This table reports the top 10 chemicals in our data set by total corporate pollution for water.

Table A3: Top 10 Land corporate pollution

Chemical name	Pounds
COPPER COMPOUNDS	1890563360.04
BARIUM COMPOUNDS	1524762989.33
LEAD COMPOUNDS	1073017751.90
ZINC COMPOUNDS	1021756855.45
MANGANESE COMPOUNDS	764474289.38
ASBESTOS (FRIABLE)	253917004.70
ZINC (FUME OR DUST)	240811839.09
CHROMIUM COMPOUNDS	225316161.49
VANADIUM COMPOUNDS	175717945.52
NICKEL COMPOUNDS	158276145.68

Notes. This table reports the top 10 chemicals in our data set by total corporate pollution for land.

Table A4: Correlation matrix for firm-level variables

	Ln_total	Rel_at	Rel_ni	# close to BP	Local CEO?	# facs	Log(at)	Leverage	RoA	Tobin's Q
Ln_total	1.00	0.75	0.51	0.17	-0.03	0.40	0.26	0.00	-0.08	-0.15
Rel_at	0.75	1.00	0.35	0.05	-0.03	0.21	-0.40	-0.03	-0.12	-0.12
Rel_ni	0.51	0.35	1.00	0.06	-0.01	0.13	0.18	0.01	-0.04	-0.10
# close to BP	0.17	0.05	0.06	1.00	0.36	0.34	0.17	-0.02	-0.02	-0.09
Local CEO?	-0.03	-0.03	-0.01	0.36	1.00	0.03	0.01	0.02	0.04	0.02
# facs	0.40	0.21	0.13	0.34	0.03	1.00	0.24	0.01	0.04	-0.04
Log(at)	0.26	-0.40	0.18	0.17	0.01	0.24	1.00	0.05	0.04	-0.05
Leverage	0.00	-0.03	0.01	-0.02	0.02	0.01	0.05	1.00	-0.05	-0.05
RoA	-0.08	-0.12	-0.04	-0.02	0.04	0.04	0.04	-0.05	1.00	0.42
Tobin's Q	-0.15	-0.12	-0.10	-0.09	0.02	-0.04	-0.05	-0.05	0.42	1.00

Notes. This table reports the correlation matrix for the variables included in our regression analyses. *Ln_-total, Rel_at*, and *Rel_ni* refer to the dependent variables in Table 5 and Table 6. The linear correlation coefficients are calculated after Pearson.

Statement of Personal Contribution (§6 (3) PromO)

Konzeption/Planung: Formulierung des grundlegenden wissenschaftlichen Problems, basierend auf bisher unbeantworteten theoretischen Fragestellungen inklusive der Zusammenfassung der generellen Fragen, die anhand von Analysen oder Experimenten/Untersuchungen beantwortbar sind. Planung der Experimente/Analysen und Formulierung der methodischen Vorgehensweise, inklusive Wahl der Methode und unabhängige methodologische Entwicklung.

Durchführung: Grad der Einbindung in die konkreten Untersuchungen bzw. Analysen.

Manuskripterstellung: Präsentation, Interpretation und Diskussion der erzielten Ergebnisse in Form eines wissenschaftlichen Artikels.

Die Einschätzung des geleisteten Anteils erfolgt mittels Punkteinschätzung von 1-100%

Für mindestens einen der vorliegenden Artikel liegt die Eigenleistung bei 100%.

Für den ersten Artikel liegt die Eigenleistung für

das Konzept/die Planung bei	50%
die Durchführung bei	50%
der Manuskripterstellung bei	50%

Für einen zweiten Artikel liegt die Eigenleistung für

das Konzept/die Planung bei	100%
die Durchführung bei	100%
der Manuskripterstellung bei	100%

Für einen dritten Artikel liegt die Eigenleistung für

das Konzept/die Planung bei	50%
die Durchführung bei	50%
der Manuskripterstellung bei	50%

Die vorliegende Einschätzung in Prozent über die von mir erbrachte Eigenleistung wurde mit den am Artikel beteiligten Koautoren einvernehmlich abgestimmt.

Hamburg, November 30, 2023 Simone Andrea Wagner

Statutory Declaration (§6 (3) PromO)

Erklärung

Hiermit erkläre ich, Simone Andrea Wagner, dass ich keine kommerzielle Promotionsberatung in Anspruch genommen habe. Die Arbeit wurde nicht schon einmal in einem früheren Promotionsverfahren angenommen oder als ungenügend beurteilt.

Hamburg, November 30, 2023 Simone Andrea Wagner

****

Eidesstattliche Versicherung

Ich, Simone Andrea Wagner, versichere an Eides statt, dass ich die Dissertation mit dem Titel: "Essays on Sustainable Finance" selbst und bei einer Zusammenarbeit mit anderen Wissenschaftlerinnen oder Wissenschaftlern gemäß den beigefügten Darlegungen nach §6 Abs. 3 der Promotionsordnung der Fakultät Wirtschafts- und Sozialwissenschaften vom 18. Januar 2017 verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht benutzt.

Hamburg, November 30, 2023 Simone Andrea Wagner

Ort, Datum Unterschrift Verwaltung