UNIVERSITÄT HAMBURG

Doctoral Thesis

EMPIRICAL EVIDENCE ON INTERNAL AND EXTERNAL MANAGERIAL DECISION MAKING IN SUSTAINABLE FINANCE AND DISCLOSURE

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Part I: General Introduction

1. Background

This dissertation consists of five independent articles, each of which addresses internal and external managerial decision making with respect to sustainability-related disclosures and activities. The 17 Sustainable Development Goals (SDGs), adopted by the United Nations (UN) in 2015 as part of the 2030 Agenda for Sustainable Development, address global environmental, social, and economic challenges with the objective of transforming our planet and paving the way for sustainable growth. In this context, the required transformation and sustainable growth include social and environmental aspects in addition to economic objectives (UN, 2015). These global challenges pose material risks to the economy and society on a global scale, impacting companies and their operations. In addition to public funds, achieving the SDGs will require significant private investments and actions to mitigate key risks, such as those posed by climate action failure, extreme weather events, and biodiversity loss (European Commission, 2019). In this context, the 2018 European *Action Plan: Financing Sustainable Growth* and the 2021 updated *Strategy for Financing the Transition to a Sustainable Economy* highlight credible sustainability-related disclosures as the foundation of the European sustainable finance framework to provide investors with the information they need to make informed and sustainable investment decisions (European Commission, 2021). Following this, the European Union (EU) has taken action to advance a mandatory disclosure regime for both financial and non-financial firms, the former in particular. The Corporate Sustainability Reporting Directive (Directive (EU) 2022/2464 (CSRD)), Sustainable Finance Disclosure Regulation (Regulation (EU) 2019/2088 (SFDR)), and the Taxonomy Regulation (Regulation (EU) 2020/852 (TR)) stem from the need for relevant, accurate, and comparable sustainability-related firm-level disclosures. Moreover, the proposed EU Commission Corporate Sustainability Due Diligence Directive (CSDDD) will require companies to further integrate sustainability considerations within their future strategy, align their business models with global challenges, incorporate associated sustainability risks and adequately report on all these requirements (European Commission, 2022). The importance of relevant and accurate sustainability-related information for both internal and external purposes is underscored by this observable regulatory shift. Consequently, firm-level sustainability performance and sustainability-related[1] information has received increasing attention in practice and academic research. Despite initial skepticism regarding the intrinsic value of corporate sustainability efforts (see Friedman, 1970), studies show that investors do, indeed, incorporate a company's overall sustainability performance into their risk

[1] As in other sustainability related research articles, this thesis uses the terms sustainability, sustainability-related, and environmental, social, and governance (ESG) performance and disclosure interchangeably.

perceptions. El Ghoul et al. (2011) suggest that sustainability engagement creates risk management effects, as it stabilizes future cash flows. In particular, activities in sustainability build moral capital that protects a company's reputation and operations in the event of negative incidents as stakeholders acknowledge such moral capital (Godfrey, 2005; Godfrey et al., 2009). Consequently, commitment to sustainability creates risk management benefits (i.e., a buffer function in case of adverse events) that are recognized by the capital market (e.g., reflected in lower perceptions of risk) (Kim et al., 2021).

Yet, to date, research is inconclusive, as positive, negative, and insignificant relationships have been documented between sustainability performance and financial performance (Fujii et al., 2013; Schreck, 2011; Trumpp & Guenther, 2017). This suggests that investor perceptions are contextually moderated. For example, voluntary disclosure at the firm level, in particular, represents an important channel for the transmission of information (Clarkson et al., 2013). However, it has also been shown that signals from firms (such as voluntary reporting) can be intentionally biased, ambiguous, or misleading. Nonetheless, investors and academics rely on aggregated sustainability indicators; however, these indicators diverge significantly among rating providers, leading to difficulties in understanding the effectiveness of individual components, measuring them, and evaluating the associated risks (Berg et al., 2022). Therefore, the various elements of a corporation's sustainability performance, disclosure, and related risks need to be investigated in greater detail (Edmans, 2023).

Across five independent articles, this dissertation focuses on the importance of sustainability data and information. The first two articles consider the internal perspective of a company with respect to sustainability-related information and activities. The other cluster of three articles focuses on investors' risk perceptions and sustainability-related activities and disclosures. In the following, I provide an overview of the two research questions, a summary of the articles, and the overall contribution of my dissertation.

2. Research Objective and Related Research Questions

This thesis centers upon two overarching research questions. The first contributes to the literature on the usefulness of external third-party assurances of sustainability information from an internal perspective. The second contributes to the literature that examines how and which aspects of sustainability performance and disclosure influence investors' risk perceptions.

The first research question examines the internal consequences for the firm of the external assurance on sustainability disclosures (sustainability assurance (SA)) by an independent third party. External verification, especially in this area, has become increasingly popular over

the past decade. Between 2005 and 2022 alone, the number of SA adopters among the 250 largest companies worldwide more than doubled (from 30 percent in 2005 to 63 percent in 2022) and it has become a standard service provided by the Big Four and other audit and consulting companies (KPMG, 2022). SA's primary purpose is the external verification of sustainability disclosures, internal information systems, and sustainability data reporting processes (International Auditing and Assurance Standards Board (IAASB), 2005).[2] Accordingly, prior research has investigated if and how SA promotes (perceived) external credibility and investor confidence (Simnett et al., 2009), with a focus on external stakeholders' information environment (Cuadrado-Ballesteros et al., 2017; Simnett et al., 2009). Experimental evidence among different investor settings indicates that SA on non-financial indicators increases trust and perceived relevance (Pflugrath et al., 2011), translating into lower cost of capital (Casey & Grenier, 2015), smaller bid-ask spreads (Fuhrmann et al., 2017), and higher firm value (Clarkson et al., 2019). However, there has been limited focus on the internal effects of SA beyond its impact on sustainability information and related sustainability activities (Ballou et al., 2018; Steinmeier & Stich, 2019). Thus, the first central research question of the thesis is:

(1) What are the internal effects of SA and how do they manifest?

Articles 1 and *2* provide answers to this central research question, with *Article 1* exploring direct effects, and *Article 2* investigating indirect effect channels. SA might arguably change organizations internally, as it is a blend of assurance and consulting elements (O'Dwyer, 2011; O'Dwyer et al., 2011). As noted above, previous literature has shown that SA has an impact on the external information environment. *Article 1* examines whether and, using archival data, empirically demonstrates that SA enhances a firm's internal information environment (IIE) through differences in abnormal returns of insider trades. Next, we analyze evidence collected through semi-structured interviews. The field data is mapped on Laughlin's (1991) theory of organizational change, which suggests that the SA process' impact is not limited to the underlying sustainability reporting processes of a company, but may also lead to modifications in the underlying systems (i.e., individuals and systems) as well as in the interpretative schemes (i.e., culture and mindset) of an organization. This study is the first to provide evidence of a direct effect of SA on a firm's IIE beyond the effects on sustainability reporting activities shown in the prior literature.

[2] Following Farooq and Villiers (2019), I refer to the term 'SA' as the review and assurance of sustainability reporting by an independent third party whose role is to express an opinion on credibility and reliability.

The quality of IIE is reflected in the quality of internal resource allocation decisions (Abernathy et al., 2019; Gallemore & Labro, 2015). Heitzman and Huang (2019) suggest that in the case of improved IIE, managers will rely more on internal sources of information than on external ones. Thus, *Article 2*, presented in *Part III*, investigates whether SA has spillover effects on deliberate internal managerial decisions related to resource adjustments. Analyzing field data collected in semi-structured interviews, the findings suggest that SA helps firms to acquire additional information that leads to greater resource adjustments in the event of a decline in activity levels. In doing so, this study provides the first evidence of an indirect effect of SA on the resource allocation decisions of managers. Both articles investigate the effect of SA as a specific and tangible element of sustainability performance and disclosure.

The second research question captures the extent to which sustainability activities and disclosures shape investors' perceptions of risk. Investors form their perceptions of risk based on the information available (i.e., their external information environment). Voluntary sustainability disclosures are thereby an important medium to release information externally and to reduce asymmetric information distribution (Clarkson et al., 2013). Thus, companies early on voluntarily started to report on their sustainability performance and activities, primarily to ensure accountability and legitimacy (Deegan et al., 2002). For example, as early as 1993, 12 percent of many countries' largest 100 companies voluntarily published a sustainability report in the reporting year, and the rate of voluntary reporting has increased steadily, reaching 64 percent in 2011 and 79 percent in 2022 (the 2022 rates are particularly driven by regulatory developments) (KPMG, 2022). However, companies have incentives to mimic signals or even send false signals (Connelly et al., 2011). Moreover, companies' signals regarding sustainability are often perceived by outsiders as conflicting, ambiguous, and not easy to interpret (Skarmeas and Leonidou, 2013). Hence, the second central research question addressed in this dissertation asks:

(2) How do sustainability engagement and reporting influence investors' perceptions of risk?

This thesis aims to explore three mechanisms affecting investors' perceptions of risk associated with sustainability: (i) the rationale for companies' engagement in sustainability (*Article 3*); (ii) the reporting practices of companies on complex issues (such as biodiversity) (*Article 4*); and, (iii) the specific engagement practices of companies (*Article 5*). Organizations differ in their motivations to engage in sustainability (Aguilera et al., 2007), resulting in different outcomes with respect to firm performance (Schaltegger & Burritt, 2018). *Article 3*, in particular explores

the difficulty in assessing a firm's rationales driving sustainability engagement from an investor's perspective. CEOs' management style significantly shapes decision-making and firm-level outcomes (Bertrand & Schoar, 2003); their decisions are dependent on experiences and characteristics (Bolton et al., 2013) as well as underlying social values (Boone et al., 2020), which drive them to increase (or decrease) firm-level engagement in sustainability. The results suggest that investors have difficulties in evaluating whether the motives for a CEO's decision to engage in sustainability are based on instrumental, relational, or moral motives, all of which emerge from underlying social values (i.e., self vs. other serving) (Aguilera et al., 2007; Boone et al., 2020).[3] Thus, the impact of sustainability performance on future financial performance and company risk is not always straightforward and investors treat the CEOs' sustainability reporting style as a signal in their risk assessment.

Apart from the motives for sustainability engagement, the nature and quality of the information disseminated to the market are also incorporated into investors' perceptions of risk. For instance, voluntary disclosure of carbon performance increases a company's market valuation (Matsumura et al., 2014). Much like climate change, the loss of biodiversity poses a significant risk to the economy as a whole (WEF, 2022). However, unlike climate-related disclosures, biodiversity-related disclosures (BRDs) lack consensus on performance indicators such as carbon (CO_2) emissions. Therefore, BRDs to date have been mostly qualitative and limited (van Liempd & Busch, 2013), and some companies have used BRD for legitimation and impression management purposes (Boiral, 2016; Maroun et al., 2018; Smith et al., 2019). In addition, stakeholders' response to this is a topic that has not yet been the focus of academic research. To bridge this gap, *Article 4* first assesses the quality of firms' BRDs in a global longitudinal sample and subsequently analyzes the impact on investors' risk perceptions. The results suggest that investor risk perceptions increase with high quality BRD. The paper highlights that biodiversity is a highly abstract and complex issue that is not only not easy to address using the current sustainability disclosure standards and practices for companies, but is also not easy to interpret by the capital market. By providing this perspective, this paper anticipates and contributes to the call for more granularity in sustainability and related disclosures (Edmans, 2023).

Regardless of how organizations communicate their sustainability activities, the substantive nature of sustainability-related activities is important to investors' perceptions of risk.

[3] Instrumental motives are mostly self-serving and based on maximizing shareholder wealth and related managerial compensation (Jensen & Meckling, 1976; McWilliams & Siegel, 2001). Relational motives are based on stakeholder theory and stakeholder pressure (Clarkson, 1995; Freeman, 2010). Moral motives are rooted in the desire for a meaningful existence, as explained by stewardship theory (Davis et al., 1997).

While the research shows that overall sustainability engagement is associated with lower perceived risk (El Ghoul et al., 2018; El Ghoul et al., 2011), questions remain as to which specific sustainability activities drive these assessments, as different dimensions of sustainability affect investors' concerns (Girerd-Potin et al., 2014). Using a novel dataset, *Article 5* particularly examines the relationship between a company's biodiversity management and investors' risk assessments. The findings indicate that companies with strong biodiversity management experience a lower risk of a future stock price crash. This suggests that investors are aware of risks associated with the loss of biodiversity and, indeed, value the management thereof, thus adding to the literature of the insurance-like effect of sustainability activities (Godfrey, 2005). By finding insignificant results for a variable capturing the results of these biodiversity management activities, *Article 5* is consistent with the observation in *Article 4* that reported metrics are diffuse. The following section provides a more detailed introduction to the individual articles of my dissertation.

3. Outline of the Thesis

3.1 Part II: How does Sustainability Assurance Affect a Company's Internal Information Environment?

The first study, co-authored with Alexander Bassen, Kerstin Lopatta, and Sebastian Tideman, explores whether and how SA might change a company's internal information environment. The paper was presented at internal department and university workshops, WPSF (Sustainable Finance Research Platform) workshops, and international conferences (The annual conference of the British accounting and finance association (BAFA) 2022, the annual congress of the European accounting association (EAA) 2023). The target journal is *Contemporary Accounting Research* (VHB Ranking A).

Providing trust and credibility to the intended users of sustainability-related disclosures is seen as the main objective of SA (IAASB, 2005). Therefore, research in SA has mainly focused on how investors and analysts perceive it (Casey & Grenier, 2015). Moreover, the SA process has been subject to difficulties and continuous developments from both the user and provider sides, initially lacking standards, provider dependency, and market segmentation by accounting and non-accounting firms. Consequently, research also focused on the process perception and design of SA. Thus, extant studies have not considered the internal consequences for the SA-receiving company.

Capturing the firm's internal distribution of information by differences in trading profits across different level managers in a number of US firms (Chen et al., 2018), we use archival

data to document a positive effect of SA on the IIE. In doing so, we investigate a novel and, as yet, and unresearched internal effect of SA, namely whether it improves its IIE. Next, adopting Laughlin (1991)'s framework of organizational change, my co-authors and I track the process of SA to understand its potential internal effects on firms. The IIE comprises the accessibility, usefulness, reliability, accuracy, and quantity of the data and knowledge collected, generated, and consumed within an organization. Thus, the IIE reflects the underlying quality of information systems, processes, and structures (Gallemore & Labro, 2015). We investigate how SA affects the IIE by supplementing the archival test with insights from semi-structured interviews conducted with representatives from assurance providers (N=15) and receivers (N=20) across seven countries. Considering an organization as an amalgam of *sub-systems,* the *design archetype,* and *interpretative schemes,* we identify that SA has the potential to induce change across all organizational components. In particular, our field data indicates that SA changes organizations' systems, processes, and governance structures. Further, we observe specific effect channels: SA reduces internal barriers, creates novel communication channels, breaking down silo structures, and encourages and motivates employees. Thus, it results in permanent change that has not been shown by prior literature.

Consistent with the heterogeneity identified across SA engagements by prior studies we further identify firm-specific contextual factors influencing the change potential of SA within the company. Our field data suggests, and the archival data shows empirically that top management (TM) attention and the potential of sustainability data integration moderate the relationship between SA and the IIE.

3.2 Part III: Sustainability Assurance and Resource Adjustments: The Case of Cost Asymmetry

Article 2, co-authored with Alexander Bassen, Laura-Maria Gastone, Kerstin Lopatta, and Sebastian Tideman, investigates whether and how SA might influence firms' internal management decisions. The paper was presented at internal university workshops and international conferences (the annual conference of the Global Research Alliance for Sustainable Finance (GRASFI) 2021, the annual congress of the EAA 2023), and received valuable feedback from reviewers of *The Accounting Review* and *Contemporary Accounting Research* that has been incorporated for further development. The study is currently under review by *The Review of Accounting Studies* (VHB Ranking A).

Maso et al. (2020) contend that SA providers from the accounting profession gain additional information from the SA process that they leverage in forming their financial audit options. Moreover, recent studies show that firms rely on their financial auditor to reduce their sustainability-related risks (Asante-Appiah & Lambert, 2022). The study posits that firms buying SA gain additional information from the SA process, which they leverage in their decisions, adjusting their processes and resources committed. Similar to the approach in *Article 1*, we supplement archival data with field data gathered through interviews with company representatives (N=20) and SA providers (N=15). In a first step, we investigate the SA process from a service perspective as suggested by Knechel et al. (2020). More specifically, we analyze the advisory and assurance elements throughout the SA process and derive the proposition that SA provides companies with complementary information that is useful to develop a deeper understanding of their extant operations and resources committed related to sustainability data. Moreover, SA enables managers to incorporate sustainability-related data within their decision-making, which enriches the information base from which they derive their decisions regarding resources committed.

To test our proposition, we utilize the concept of *cost-stickiness*. According to cost theory, resources (and their associated costs) are either of a fixed or variable nature (Cooper & Kaplan, 1992). However, according to Anderson et al. (2003), most resources are neither fixed nor variable; rather, they are sticky. Downsizing in the short term incurs significant adjustment costs and, according to Anderson et al. (2003), this is why, while managers expand their resources (and associated costs) quickly in the event of an increase in activity levels, they are reluctant to reduce resources (personnel, machinery, etc.) in the event of a decline in activity levels (i.e., a phenomenon that is referred to as *cost-stickiness*). Uncertainty due to inadequate internal information regarding the future and the existence of unused resources results in lower adjustment rates of resources (Kim et al., 2019). Thus, we argue that complementary information arising from the SA process enhances the underlying set of information and thereby reduces delays in resource adjustments. Prior literature indicates that a delay in resource adjustments might be beneficial for a company to some degree as it avoids, for example, costly dismissal and potential rehiring costs. However, some sources of cost-stickiness evolve out of self-serving managerial intentions being detrimental to firm value (Chen et al., 2012). As we argue that SA-related information reduces the bad part of sticky-cost behavior, we hypothesize that the resource adjustments related to SA are positively related to firm value.

Building on a global sample of firms across 40 countries, the methodology of this article uses a two-step approach. First, the influence of SA on resource adjustments is tested, enlarging

Anderson et al.'s (2003) model of asymmetric resource adjustments (captured by total and sales, general, and administrative (SG&A) costs) with SA as an additional determinant. The results show that SA results in larger resource adjustments in the event of a decline in activity levels (i.e., *reduces cost-stickiness*). Next, building on Kaspereit and Lopatta's (2019) approach, we construct a firm-year-level measure for the resource adjustments attributable to SA. We document that the resource adjustments attributed to SA are positively associated with *Tobin's q* (our proxy for firm value). We additionally show that these results are robust for two different definitions of our *Tobin's q* variable.

3.3 Part IV: The Moderating Role of CEO Sustainability Reporting Style in the Relationship between Sustainability Performance, Sustainability Reporting, and Cost of Equity

The third study, co-authored with Kerstin Lopatta, Thomas Kaspereit, and Sebastian Tideman, addresses the question of whether investors perceive CEOs' sustainability reporting style as a signal and if they assess company risk as a function of sustainability performance that is moderated by sustainability reporting. The paper was presented at internal university workshops and international conferences before being published in January 2022 in the *Journal of Business Economics* (VHB Ranking B).

The role of CEOs in shaping a company's sustainability performance has been the subject of much research (among many others, Cronqvist & Yu, 2017; Jiraporn & Chintrakarn, 2013), with evidence suggesting that CEOs' social values and motives influence their decision-making in this area (Boone et al., 2020). However, it might be difficult for investors to evaluate whether a CEO's decision to engage in sustainability is based on instrumental, relational, or moral motives (Aguilera et al., 2007; Fujii et al., 2013). Thus, the potential impact of sustainability performance on future financial performance and company risk is not always clear. Prior research has documented positive, negative, and non-significant sustainability performance financial performance relationships (Fujii et al., 2013; Schreck, 2011; Trumpp & Guenther, 2017).

Building on social values driving CEOs' motivation for sustainability engagement (Cronqvist & Yu, 2017; Davidson et al., 2019) as well as their motivations related to corporate transparency and the quality of corporate financial reporting (Bamber et al., 2010; Davidson et al., 2015), we hypothesize that CEOs' social values and preferences influence a company's sustainability reporting. Based on signaling and attribution theory (Connelly et al., 2011), we argue that a deviation from the average CEO (i.e., a CEO's style of sustainability reporting), is

a signal disseminating information about the motives underlying sustainability performance to the external environment (Ogunfowora et al., 2018). As signals about sustainability sent by companies are rather ambiguous and often perceived by outsiders as conflicting (Skarmeas & Leonidou, 2013), we argue that sustainability reporting is essential in order to reduce information asymmetries, thus, moderating the relationship between sustainability performance and implied cost of equity (i.e., investors' risk perceptions). Hence, we propose a three-way moderation between sustainability performance, sustainability reporting, and CEOs' style of sustainability reporting.

The methodology of this article, similar to that of *Article 2,* employs a two-stage approach as we investigate whether the CEO's sustainability orientation significantly influences the quality and scope of a company's sustainability reporting and whether this reporting style conveys a signal to investors about the company's sustainability performance. As sustainability reporting is a multidimensional construct containing quantitative and content-based dimensions (Michelon et al., 2015), we construct a measure for sustainability reporting using five equally weighted sustainability reporting items from the Refinitiv ESG (formerly Asset4) database. First, we apply the mover dummy approach from Bertrand and Schoar (2003) to calculate CEO-fixed effects on a sample of US companies. Our results show that CEO-fixed effects significantly explain sustainability reporting at the firm level, supporting our first hypothesis. In the second step, we test the moderating relationship between sustainability performance, sustainability reporting, and CEO-fixed effects, and their impact on the implied cost of equity. Our results show that CEOs with a high (low) fixed effect on sustainability reporting are associated with an increase (decrease) in the cost of equity related to a marginal increase in sustainability performance, moderated by sustainability reporting. These findings support our second hypothesis and suggest that capital market participants use CEO-fixed effects on sustainability reporting as an indicator of the motives and social values underlying corporate engagement in sustainability. The study highlights that investors value sustainability activities perceived to be driven mainly by instrumental motives, as long as they add value for shareholders and do not provide CEOs with the opportunity to pursue ambitions detached from business objectives. Moreover, this article shows how TM shapes (long-term oriented) sustainability reporting, as well as (backward-looking) financial information (e.g., Levy et al., 2018), adding a new company-specific factor driving firm-level sustainability reporting (e.g., Brammer & Pavelin, 2006).

3.4 Part V: Evolution, Motives, and Perception of Biodiversity-Related Disclosures: The Application of GRI 304

In the fourth study (single-authored), I investigate firms' biodiversity-related disclosures (BRDs) and investors' perception of risks. The paper is a recent working paper, has been presented at internal university seminars and is under consideration by the *European Accounting Review* (VHB Ranking A).

Since the UN declared the *Decade of Biodiversity* in 2010, a number of frameworks and studies have been established to address the loss of biodiversity. With extinction rates at unprecedented levels (Pimm et al., 2014), biodiversity loss and human alteration of ecosystems in general are considered to be among the greatest challenges of our time, along with climate change (WEF, 2022), presenting society and companies with immersive risks (Dasgupta, 2021; IPBES, 2019). Yet, while there is extensive research focusing on climate change that shows that investors incorporate climate risk in their assessments (Krueger et al., 2020; Painter, 2020), the extent to which companies and investors perceive biodiversity loss is still unclear as recent studies have focused solely on climate change, carbon performance, and associated risks.

Companies' self-reported climate-related performance is valued and factored into investors' risk perceptions (Matsumura et al., 2014). In this regard, high-quality information has a positive impact on investors' risk perceptions (Clarkson et al., 2013). Previous studies addressing BRD have been limited to a specific country (van Liempd & Busch, 2013), industry (Adler et al., 2017), or point in time (Adler et al., 2018), concluding that BRD tends to be limited, selective, and prone to impression management. This raises the question of whether or not investors are incorporating BRDs into their perceptions of risk.

This study combines manual content analysis of BRDs in sustainability reports with multivariate regression analysis. Following previous studies with similar approaches (e.g., Michelon et al., 2015), I assess the quality of BRDs according to the items required by the Global Reporting Initiative (GRI) standards. I analyze the content of 2,843 sustainability reports published between 2010-2019 in 43 countries under the topic specific GRI standard on biodiversity (GRI 304). Furthermore, I collect the quantitative measures of the reports as required by GRI 304. Overall, I do not observe an increase in the adoption of the GRI topic-specific standard 304 (or any of its individual elements), nor do I observe an increase in the quality of the BRDs over time. Furthermore, the results indicate an inconsistent application of the GRI 304 standard and a low level of comparability between the different BRDs. In a subsequent analysis, I show that companies that self-disclose through their responses to the Carbon Disclosure Project (CDP) questionnaire regarding their exposure to material climate risks produce BRDs of higher

quality. Surprisingly, tying executive compensation to climate-related actions reduces the quality of the BRD. Second, following previous studies, I capture investors' risk perceptions via the implied cost of equity capital (e.g., Dhaliwal et al., 2016). By conducting multivariate regression analyses, I find that firms with a higher quality of BRD are perceived to be exposed to a higher level of financial risk. These results suggest that BRD is complex, not comparable in its current form, and rather confusing for investors. Another possible explanation could be that investors do not have the same level of awareness of the risks associated with biodiversity, and only become aware of them when a company reports on them and they then adjust their risk assessment accordingly.

3.5 Part VI: Biodiversity Management and Stock Price Crash Risk

The fifth article, co-authored with Alexander Bassen, Daniel Buchholz, and Kerstin Lopatta analyzes whether strong biodiversity management mitigates a future financial risk. The working paper was presented at internal seminars, is accepted at the annual conference of the GRASFI 2023 and is invited for resubmission by the *Journal of Business and Society* (VHB Ranking B).

Nature-related risks are predicted to manifest as the major risks within the next 10 years (WEF, 2022). These risks, such as those arising from biodiversity loss, are distinct from the non-financial risk factors analyzed by prior literature. Most importantly, they depict salient and large-scale issues (Dasgupta, 2021). Based on previous research indicating that strong environmental management reduces a firm's future financial risk (Kim et al., 2014), we argue that strong biodiversity management reduces a firm's financial risk through mitigation or reduction in exposure to biodiversity risks. Our rationale is that companies that focus on managing their impacts and dependencies on biodiversity are demonstrating that they value intact ecosystems and biodiversity. In other words, these corporations are signaling that they are actively managing the pressures their operations place on biodiversity as well as working on solutions to reduce their dependency on ecosystems and their services.

Our global sample of companies was constructed using a new global biodiversity management data set provided by Vigeo Eiris, a subsidiary of Moody's. Our proxy for financial risk is stock price crash risk, a frequently applied measure to assess the risk of substantial negative stock returns (Habib et al., 2018; Kim et al., 2014). The results show that firms with stronger overall biodiversity management experience a reduction in stock price crash risk. We then conduct an interaction analysis and find that firms needing legitimacy (i.e., those with low overall sustainability performance or low profitability) see their crash risk decrease when they receive positive stakeholder feedback on their biodiversity management and activities. We combine our

sample with US environmental inspection data in an additional analysis. We find for a sample of North American companies, that firms that have been inspected experience an increase in crash risk in the following year; this suggests that the inspections reveal negative information related to operations that would otherwise have been withheld by companies. Thus, information on a firm's mismanagement of biodiversity in the context of its operations is a potential financial risk factor. Additionally, this analysis incorporates an external shock and thus provides preliminary evidence for a causal relationship. Thus, the inspection of a firm's facilities acts as a channel through which new (potentially negative) information about biodiversity management is revealed to the public. Robustness checks show that biodiversity management is not simply an indicator of corporate sustainability awareness. We construct a control variable – firm internal sustainability awareness – proxied by the number of sustainability-related policies identified using the Refinitiv ESG database a firm has in place, and find that our results hold when including this variable.

4. Contribution and Avenues for Future Research

Overall, each article of this thesis responds to recent calls for future research to focus on single elements of sustainability and shape more granular views of how sustainability performance and disclosures generate value and shape investors' perceptions.

By answering the first central research question of this thesis, the results of *Articles 1* and *2* contribute to the debate on the usefulness of SA (DeFond & Zhang, 2014). Several studies document the beneficial effect of SA on the external information environment in line with increased credibility through external verifications of disclosures (e.g., Casey & Grenier, 2015). *Articles 1* and *2* show that SA also has beneficial internal effects. By establishing the direct link between SA and IIE subject to cross-sectional variations, this thesis shows that SA has an overall internal effect beyond enhancing the external information environment. By indicating a spillover effect of SA on managerial decision making we show empirically that SA has an effect on internal managerial decision-making, which has only been shown in the external context so far.

Moreover, while prior studies suggest change related to the design archetype induced by SA (i.e., enhanced sustainability reporting processes and quality of sustainability-related data) (Canning et al., 2019; Channuntapipat, 2021; Channuntapipat et al., 2019; O'Dwyer, 2011; O'Dwyer et al., 2011), *Article 1* provides qualitative evidence that the SA process can result in change related to the organization as a whole. *Article 2* extends this finding and shows how companies gain valuable information regarding resource adjustments through the SA process.

Further, *Article 2* adds to the literature on factors influencing deliberate management decisions regarding resource adjustments (along with many others, Anderson et al., 2003; Chen et al., 2012). Thereby, *Article 2* adds a new perspective in this context and shows that financial reporting activities are not the only way to gain a deeper understanding of a firm's operations (Kim et al., 2019). Moreover, prior research so far has suggested that the tendency to under-adjust resources during a decline in activity levels harms a firm's external information environment (Ciftci et al., 2016; Weiss, 2010), and internally results in lower synergies in merger and acquisition (M&A) deals (Jang & Yehuda, 2021). We complement this internal perspective by showing that resource adjustments attributable to SA increase firm value.

By providing answers to diverse aspects of the second central research question, this thesis contributes to signaling theory literature related to sustainability (e.g., Connelly et al., 2011). While there are many signals to the market in the sustainability context, stakeholders still struggle to evaluate the motives behind such signals as sustainability performance. *Article 3* contributes to the literature that considers CEOs as signal senders vis-à-vis stakeholders in the sustainability context, which has only been backed up by experimental research (Ogunfowora et al., 2018). *Article 4* highlights the difficulties of specific topics within sustainability reporting (i.e., BRD), and how investors translate signals of mostly qualitative information in this case (Plumlee et al., 2015). Further, *Articles 3* and *5* add to the literature investigating the relationship between sustainability performance and perceived risk (El Ghoul et al., 2011). *Article 3* provides insights into two specific moderators of this relationship (i.e., sustainability reporting and CEOs' sustainability reporting style) while *Article 5* inspects a potential performance channel mitigating risk perceptions (i.e., biodiversity management).

With *Articles 4* and 5 focusing on biodiversity loss as an emerging topic, this thesis also adds to the emerging literature on biodiversity reporting and engagement. Biodiversity risk not only drives companies to report (Carvalho et al., 2022), it is also reflected in the company's risk profile, opening new strands in the literature. The ongoing development of sustainability reporting and disclosure standards are opening up potential research avenues that future studies might consider. More specific reporting and measures are necessary for the future, linking scientific and environmental accounting research.

Lastly, this thesis also responds to Soltes' (2014) call to combine multiple data sources to answer research objectives more comprehensively with *Articles 1* and *2* combining field and archival data in their methodological approach in order to gain a deeper and more comprehensive view of the research objective. Particularly with the ongoing rapid regulatory developments

in the area of sustainability and disclosure, this may inspire more researchers to adopt similar approaches, as a purely outside view does not provide enough detail in all instances.

Given the highlighted momentum and the ongoing regulatory development with regard to sustainability performance and disclosures, this thesis provides insights and practical implications for investors, regulators, and companies (both SA receiving and providing). First, *Articles 1* and *2* indicate that SA has *internal* economic effects for firms. The securities exchange commission (SEC) underpins the rising importance of reliable sustainability data (SEC, 2022). In addition, with the introduction of the CSRD (Directive (EU) 2022/2464, 2022), SA will become mandatory for approximately 50,000 companies in the EU in 2024. Our study could also contribute to the regulators' debate on the usefulness of SA, as it suggests that the effects are also present internally. Moreover, our findings might also give some indications of how companies and SA providers could think about their SA engagement.

Additionally, this thesis provides particular insights for companies and their top managers. In particular, *Article 3* shows how the perception of sustainability performance influencing the cost of equity capital is moderated by how top management shapes the sustainability reporting style of the company. With the results provided by *Article 1*, this thesis shows companies how important the top management is for implementing a sustainability strategy, which includes the reporting and the effectiveness of the SA process.

The results provided in *Article 4* further highlight the need for consistent sustainability disclosure standards and the difficulties in providing comparable disclosures (especially for complex topics such as impacts on and dependencies on intact nature, and biodiversity loss). With regard to the current development of BRD, our findings in particular show that while companies provide some disclosure on biodiversity, it is of low quality and lacks comparability. Our findings also suggest that although companies struggle to disclose their biodiversity impacts and activities, investors nonetheless value biodiversity management approaches. Thus, *Article 5* provides companies with a channel to manage their risk exposure.

5. References

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Part II: How Does Sustainability Assurance Affect a Company's Internal Information Environment?

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1. Introduction

Does sustainability assurance (SA)[4] change a firm's internal information environment (IIE)? In this study, we investigate a novel and as yet unresearched channel within firms of SA, namely whether SA improves a firm's IIE. Our research is motivated by the fact that SA has become a mainstream service over the last decade—especially in the European context, and has considerable untapped potential in the United States (US) market (KPMG, 2015, 2017, 2020, 2022). Prior research has investigated whether and how SA promotes (perceived) external credibility (Simnett et al., 2009) and how it alters the information environment of external stakeholders (Casey & Grenier, 2015; Cuadrado-Ballesteros et al., 2017; Simnett et al., 2009). Yet, we still know relatively little about the within-firm effects of SA on internal managers. Meanwhile, SA providers highlight its potentially beneficial effects on information systems and processes as one of its core selling points,[5] as it is a blend of assurance and advisory elements (O'Dwyer, 2011). Others, however, have argued that SA is merely a symbolic and costly act that creates no value for either companies or the intended users of environmental, social, and governance (ESG) disclosures (e.g., Michelon et al., 2015). In view of the increasing importance of SA for firms— both providers and recipients—a better understanding of its intra-firm effects is crucial. Within this perspective, the IIE, that is, the accounting and non-accounting information available, requires particular attention as managers make all their strategic and operational decisions based on this (Dorantes et al., 2013).

The development of SA as an assurance service is characterized by its differences from financial assurance and the complexities of its application (O'Dwyer, 2011). It should also be noted that, given the unregulated environment of SA, there is heterogeneity across SA engagements (e.g., scope and depth) and SA providers (Channuntapipat et al., 2019). Meanwhile, due to its originally voluntary nature and the different types of providers (i.e., *accounting* vs. *non-accounting firms*), the research focus within the tripartite SA relationship[6] has mainly been on providers and users. In relation to providers, for example, studies have examined how accounting firms confer legitimacy on their service offering (O'Dwyer et al., 2011) or the different perceptions and attitudes toward the service among different provider types (Farooq & Villiers, 2019a). With respect to SA users, research specifically examines users' perceptions of externally verified ESG

[4] Following Farooq and Villiers (2019a), we use the term 'SA' to refer to the review and assurance of environmental, social, and governance disclosures by an independent third party whose role is to express an opinion on credibility and reliability.

[5] For example, Ernst & Young states in one of its promotional materials that SA leads to increased efficiency. Specifically, they claim that the main advantage of sustainability assurance is an "enhanced understanding of risks and opportunities and the broader picture of [an] organization's impact areas leading to an improved decision-making process" (accessed via https://assets.ey.com/content/dam/ey-sites/ey-com/en_kz/topics/homepage-banners/ey-sustainability-services-eng-web.pdf on 28 July 2023).

[6] An SA engagement typically involves three parties (i.e., the assurance provider, the receiving firm, and external users) (International Auditing and Assurance Standards Board, 2021).

disclosures. There is evidence that SA contributes to the information environments of both users and providers (Martínez-Ferrero & García-Sánchez, 2017; Maso et al., 2020). In particular, Maso et al. (2020) indicate that accounting firms that also provide SA gain valuable information during the SA engagements that they utilize in their financial audit opinions. Yet, we know little about the effects of SA on the internal information environment of the receiving firm. Thus, we aim to answer the overarching question of *whether and how SA affects a firm's IIE within an SA engagement.*

Before we address the *how* aspect of our research question, we first aim to establish a robust causal link and test the relationship between the SA and the IIE using archival data (i.e., addressing the *whether*) by analyzing publicly available SA information (i.e., SA statements). To answer the *how* in our question we then open the corporate black box and combine field and archival data to better understand the nature, processes, and effects of SA. In the combination of qualitative and quantitative data sources used in our research approach, we follow Soltes' (2014) call to enhance empirical results with multiple data sources in order to obtain a more comprehensive understanding of the researched question.[7]

Following Chen et al. (2018) we utilize the absolute difference in average cumulative abnormal returns of insider trades between top and divisional managers as a proxy for the IIE. Differences in gains from insider trading are indicative of different sets of information between organizational groups, and thus capture asymmetric sets of information within a firm.[8] Lower unsigned (absolute) values of such differences capture the equal distribution of the internal information within a firm, indicating a good IIE. Given the availability of data on insider trades, our tests with archival data focus on US firms only. We draw our sample from all available observations at the intersection of the Thomson Reuters (TR) TFN Insider Filing database, Compustat annual files, and the TR Refinitiv ESG database, resulting in 996 firm-year observations covering the period 2005–2021. We document an overall positive link between SA and IIE to an economically meaningful extent. Specifically, SA reduces differences in average abnormal returns from insider trades by 31.15 percent (in relation to the sample mean). We supplement our main results

[7] Soltes (2014) explicitly points out the value of field data for hypothesis development and validation of relationships in accounting research. As such, field data are an important complement to archival data. Since the SA process is not observable from the outside and communication concerning the SA process tends to be selective and strategic (Boiral & Heras-Saizarbitoria, 2020), we conducted interviews with company insiders and SA providers involved in SA.

[8] Unlike all other previous proxies for a corporate IIE that have been established by the literature to date (e.g., speed of earnings announcements; financial restatements; presence, frequency, and accuracy of management earnings forecasts) (Dorantes et al., 2013), this measure of IIE is not linked to aggregated financial reporting. It hence allows us to capture within-firm differences in information distribution.

with further robustness tests. We control for potential self-selection using a Heckman (1979) correction because SA is a voluntary service in the US In addition, we perform matched sample analyses (both propensity score matching and entropy balancing) to further mitigate identification concerns.

To explore the particular channels of how SA affects a company's organizational structures constituting its IIE, we collected field data via semi-structured interviews with 35 participants from seven countries including the US: 15 professionals giving assurance on ESG disclosures and 20 firm insiders responsible for SA. We structured the interviews around three key themes: the motivation for SA, the SA process, and SA-related outcomes. In particular, the SA process and its outcomes were used to address our research objective. With our focus on motivation for SA at the beginning, we intended to set the stage and have a 'soft opening' to the interviews.

Our field data provides insights into both the SA process and how its outcomes manifest. We utilize Laughlin's (1991) framework to systematically analyze organizational change induced by SA. Hereafter, an organization is composed of three components: the *design archetype* (organizational structures), *sub-systems* (tangible elements), and *interpretative schemes* (values and beliefs). Modifications triggered by an external prompt are referred to either as *first-order change* (only the design archetype and underlying sub-systems are modified and these changes are rather transitory) or *second-order change* (all three components are modified and these changes are permanent). We followed Laughlin's framework since existing research on the SA process has pointed mainly to modifications that are related to *first-order change*, whereas we were interested in exploring whether SA leads to sustained *second-order change*. Hence, to examine the type of change brought about by the SA process, we categorize our field data according to the three components. Next, we map the effects of the SA process on the components to two dimensions of the IIE, namely the *quality* and *scope* of information, as the IIE is shaped by the accessibility, usefulness, reliability, accuracy, and quantity of all data and knowledge collected, generated, and used within an organization (Gallemore & Labro, 2015).

Our field data indicate tangible modifications in the underlying sub-systems[9] across two categories (adjustments to the underlying technical systems, and shifts in the responsibilities and roles of individuals) and changes pf an intangible nature to the design archetype.[10] Thus, modifications extend to new governance and management structures. Specifically, prior research has extensively noted that robust processes and controls foster data quality (Feng et al., 2009). Beyond

[9] That is, modifications affecting physical elements such as individuals or technical systems.
[10] That is, modifications affecting non-physical elements such as structures.

that, the SA process creates alternative channels and routines of communication that facilitate relationships and horizontal exchanges between headquarters, sites, facilities, and subsidiaries as well as vertical ones.[11] Further, SA providers help bridge disparate functions in different units, suggesting knowledge exchange and learning effects. It also creates awareness of sustainability matters and highlights the relevance of these issues across the workforce. In addition to technical documentation and implementation, those performing control functions in particular need the ability, motivation, and resources to perform these duties effectively (Guo et al., 2016).

Prompted by our field data (i.e., heterogeneous effects induced by SA and contextual factors that might moderate the effect of SA described by corporate insiders and SA providers), we extended our archival data analysis. Given that our field data suggest that the amount and quality of information increases via SA for both top management (TM) and the divisions, archival data also shows that the IIE is especially elevated when there is an information advantage for the TM prior to the SA process, indicating improved information exchange with, and awareness among, divisions. Further, as suggested by interview insights, the relationship between SA and IIE is positively moderated by a company's ESG integration potential and TM attention.

By providing answers to our research question, our study first establishes an overall robust causal link to show that SA does affect the IIE, and then turns to our main contribution, addressing and showing that the specific internal firm effect channels how the SA process affects the IIE. In particular, with our results from the field data, we answer the call to investigate the (internal) effects of SA (DeFond & Zhang, 2014). To date, prior research has only identified effects of SA on ESG reporting (i.e., process design, documentation, and internal controls) (Canning et al., 2019; O'Dwyer, 2011; O'Dwyer et al., 2011). Thus, prior studies suggested *first-order changes* induced by SA (i.e., enhanced ESG reporting processes and quality of ESG-related data) (Canning et al., 2019; Channuntapipat et al., 2019; O'Dwyer, 2011; O'Dwyer et al., 2011). *First-order changes*, in general, tend to be not permanent, and are likely to revert to the baseline configuration (Laughlin, 1991). In contrast, our study provides evidence that the SA process can also result in *second-*

[11] This additional communication allows for the detection and communication of operational inconsistencies when processing and reviewing data from operational processes.

order changes within an organization (i.e., influencing employee awareness, unlocking silo structures, and establishing new routines) leading to sustained organizational change.[12] These lasting transformations counter the criticism that SA is more of a symbolic act executed by firms (Michelon et al., 2015).

Our study also has several practical implications relevant to investors, regulators, and companies. We show that SA has internal effects that go beyond the primary goal of strengthening investor confidence. Given the momentum around ESG, this is especially true for companies in the US, where the SA market is less developed.[13] The securities exchange commission (SEC) has underlined the increasing importance of reliable ESG data through its proposed rule on mandatory reporting of climate-related disclosures (SEC, 2022). Specifically, the rule proposes mandatory SA of carbon emissions disclosures and intends a strong link between climate-related matters and financial reporting. In addition, through the European Union's (EU) Corporate Sustainability Reporting Directive (CSRD) (EU Commission, 2021),[14] the scope of ESG reporting and the number of reporting companies in the EU is set to expand. The CSRD also includes mandatory SA. In the regulators' debate on the usefulness of SA, our study is helpful as it suggests that SA not only affects the (external) credibility of sustainability disclosures, but also triggers permanent and robust modifications that shape the IIE in the long term.

The remainder of this paper is organized as follows. Section 2 reviews the literature and introduces our research question. Section 3 contains the archival methodology to link SA and IIE, and Section 4 presents the corresponding results. Section 5 answers our research question by analyzing field data, followed by Section 6 including additional analyses. Section 7 concludes.

2. Prior Literature and Research Question

2.1 The Sustainability Assurance Process

The concept of assurance implies increased credibility and transparency (International Auditing

[12] Prior research on the financial control environment has shown that the implementation of new technical control systems is beneficial to a company's financial reporting environment. For example, Masli et al. (2010) show a lower probability of material restatements. In contrast, the ESG-related reporting environment involves disparate systems, data sources, and departments relative to the financial reporting environment (O'Dwyer 2011). As such, the financial landscape is not transferable because ESG-related reporting environment and SA face different challenges and heterogeneity, as highlighted at the beginning of this section. Nevertheless, the nature of the potential changes we have identified may also be applicable to changes related to financial audits. This could, in particular, expand the implications for practitioners if companies begin to use audits as a service rather than a simple act of verification (Knechel et al. 2020).

[13] Only 60.58 percent of US firms are engaged in SA as of 2020 (vs. 79.25 percent of non-US firms) (based on the full TR Refinitiv ESG universe).

[14] The CSRD's proposal was adopted by the European Commission in April 2021 and by the European Parliament in November 2022.

and Assurance Standards Board, 2021). Consequently, the main potential benefit of SA was originally viewed as increasing the transparency of ESG reporting and thereby achieving accountability to stakeholders (Ball et al., 2000). Indeed, research on the drivers motivating firms to opt for this service suggests that firms use SA to enhance the credibility of their ESG reporting and build reputation and legitimacy (Simnett et al., 2009). Hereby, a firm's decision to adopt SA depends on its corporate governance and regulatory context (Simnett et al., 2009).[15] However, as well as the particular firm characteristics that capture the interest of stakeholders (Sierra et al., 2013; Simnett et al., 2009), a firm's internal attitude toward ESG issues also matters (Maroun, 2020). This supports the notion that SA could be a useful internal tool to detect deficiencies in reporting and underlying control systems (Edgley et al., 2010).

However, due to SA's unregulated nature, different dynamics, and heterogeneity in terms of application, much criticism has been leveled at SA as an assurance service since its early days. Particular criticisms include the initial absence of assurance standards, the laxity of such standards, and the lack of professional standardization in assurance practice (Gray, 2000; Manetti & Becatti, 2009). As well as weak standardization, SA has also been accused of being vulnerable to managerial capture (Ball et al., 2000; Manetti & Toccafondi, 2012), lack of stakeholder inclusiveness (Ball et al., 2000; O'Dwyer & Owen, 2005), and for its potential for client dependency (Boiral, Heras-Saizarbitoria, Brotherton, & Bernard, 2019). Although the SA process has improved in response to this criticism—for example, showing signs of increasing stakeholder inclusion (Edgley et al., 2015)—challenges persist. The independence and quality of SA are still subject to conflicting forces, namely client pressure and SA providers seeking to increase SA revenues (Farooq & Villiers, 2019a).

Moreover, SA assurors acknowledge emerging ethical dilemmas due to the commercialism of SA, the alleged symbolic nature of the service, the potentially blurred lines between assurance and consulting services, and familiarity with clients (Boiral, Heras-Saizarbitoria, Brotherton, & Bernard, 2019). Hence, rather than being critical and pointing out limitations, SA statements may merely highlight areas for future development (Boiral, Heras-Saizarbitoria, & Brotherton, 2019). In addition, evidence from different provider types (i.e., accounting vs. non-accounting firms) leads to questions around providers' ongoing professionalization, standardization, and knowledge (Boiral, Heras-Saizarbitoria, Brotherton, & Bernard, 2019). Thus, there is concern that SA is a service that is more of a symbolic act than an instrument of in-depth scrutiny (Boiral, Heras-Saizarbitoria, Brotherton, & Bernard, 2019; Michelon et al., 2015).

[15] For instance, firms in stakeholder-oriented countries are more likely to adopt SA (Kolk & Perego, 2010; Simnett et al., 2009). In terms of internal governance, according to Al-Shaer and Zaman (2018), audit committees encourage firms to engage in SA.

2.2 Sustainability Assurance and the External and Internal Information Environment

As SA is still voluntary in the most jurisdictions,[16] it can serve as a signal to reinforce the credibility and importance of the assured content to the intended users (Cheng et al., 2015). Experimental studies indicate that financial analysts (Pflugrath et al., 2011), professional investors (Reimsbach et al., 2018), and non-professional investors (Cheng et al., 2015) all perceive ESG information as more credible and relevant if it is assured.[17] Improved credibility, perceived relevance, and quality of disclosed ESG information due to SA translate into a better information environment for market participants. Evidence of greater transparency is reflected in smaller bid–ask spreads (Fuhrmann et al., 2017), lower cost of capital, and higher market valuations (Casey & Grenier, 2015; Clarkson et al., 2019). Related to SA providers, Maso et al. (2020), infer that SA supplements SA providers with incremental information that they use within their financial audit engagements.

The internal effects of SA are often considered equally important (O'Dwyer, 2011; O'Dwyer et al., 2011; Owen et al., 2000). Besides the perceived quality of the assured content, SA can also affect the underlying quality of the published information. Assurors frequently make recommendations regarding data definitions and control systems, which could result in more accurate ESG data (Boiral, Heras-Saizarbitoria, & Brotherton, 2019; Maroun, 2019). It is worth noting that the internal implementation of these recommendations cannot be assessed from the outside. While it can be observed that SA increases the likelihood of error-driven restatements (Ballou et al., 2018), the increase in these also permits the assumption that providers rather use these restatements as a vehicle to achieve legitimacy for SA (Michelon et al., 2019). In this regard, evidence shows that SA does not improve the quality of ESG reporting as measured by ESG report characteristics (Michelon et al., 2015). However, according to Hummel et al. (2019), firms with poor ESG performance and weak internal systems seek deeper forms of SA to improve their ESG-related systems and processes.

In particular, Cohen and Simnett (2015) emphasize the importance of ESG information and related external verification for internal decision-making. Steinmeier and Stich (2019) indicate a link between SA and a firm's optimal ESG activities. However, SA-induced changes that go beyond the ESG (reporting) context, such as the overall IIE, have not yet been demonstrated. Given

[16] At present, only a few countries have made SA mandatory. These include South Africa, where companies listed on the Johannesburg Stock Exchange are required to provide integrated reporting. In addition, following the local implementation effective since 2018 of the Non-Financial Reporting Directive, Spain and Italy have made SA obligatory for the mandatory ESG reporting.

[17] These studies considered different application levels, reporting formats, and attitudes in different countries (Pflugrath et al., 2011; Cheng et al., 2015; Reimsbach et al. 2018).

the above-mentioned criticism of SA practice as a symbolic act, it remains an open empirical question as to whether SA does, indeed, improve a firm's IIE:

Research Question: Does SA affect a company's IIE and, if so, how?

3. Methodology

3.1 Measurement of the IIE

Before analyzing the specific channels through which SA might affect a firm's IIE, we establish a robust relationship between SA and IIE using archival data. For our empirical proxy capturing a company's IIE, we follow Chen et al. (2018) and utilize information on insider trading to gauge the distribution of information within a firm. This approach builds on the rationale that managers (regardless of their level and location) are processing private information. Differences in their underlying information sets are *ex-ante* unobservable, but *ex-post* revealed by differences in the realized returns of their trades in their own firm's stock (insider trades). These return differences provide us with the opportunity to measure the differences in information distribution between organizational groups (i.e., all else being equal better-informed managers realize higher trading returns).[18]

We follow Chen et al (2018) and classify insider trades as either 'routine' or 'opportunistic' according to their logic based on the assumption that insider trades are either motivated by liquidity purposes or based on private information.[19] Since we are interested in trades that were likely prompted by private information, we limit our sample to opportunistic trades only. As organizational groups we included top managers—as they are aware of the overall strategy and a firm's future, and divisional managers—as they have operational details and execute strategy and plans. Thus, we calculate the average trading profit resulting from opportunistic insider trades for each group (top managers (*TOP_RET)* and divisional managers *(DIV_RET)* as the cumulative market-adjusted abnormal return over the subsequent six-month period dur-

[18] This approach is preferable to other proxies for IIE, such as internal control weaknesses (Feng et al., 2009), frequency and accuracy of management earnings forecasts (Dorantes et al., 2013), earnings announcement speed, and financial restatements (Gallemore & Labro, 2015). These other measures are limited to the financial reporting environment as they capture the centralized information environment rather than the distribution of information within the company. Yet the *within-company* distribution of information is the construct of interest in our study.

[19] We classify trades as 'routine' if the same insider performed an open market trade in the same calendar month over a period of three consecutive years. All others are labeled as 'opportunistic'. This approach follows the application of Chen et al. (2018) and is in line with the framework of Cohen et al. (2012).

ing the previous two fiscal years ($year_{t0}$ to $year_{t-2}$). For the exact classification of the TFN insider data into top or divisional management, we follow Chen et al. (2018).[20] Their measure capturing asymmetric internal information distribution *(DIFRET)* is calculated as the difference between *DIV_RET* and *TOP_RET* to capture the information (dis-)advantage between the two groups. Hence, a negative (positive) value of *DIFRET* indicates an information advantage in favor of top (divisional) management, implying asymmetric information distribution. We capture the overall IIE (*INTIE*) as the absolute difference in trading profits *(|DIFRET|)* as proposed by Chen et al. (2018) since we are interested in the aggregate information environment (i.e., how equally the information is distributed within a company) and not whether divisional *or* top managers have an information advantage. An optimal IIE would imply identical information sets available to all divisional and top managers (i.e., no differences in trading profits). For ease of interpretation, we multiply |*DIFRET*| by -1 (Huang et al., 2020). Thus, a less negative value (i.e., a value closer to the maximum value of 0) indicates more equally distributed information between divisional and top managers, suggesting a better IIE. Thus, positive (negative) regression coefficients will indicate a better (worse) IIE.

3.2 Relationship between SA and the IIE

For our baseline test of whether SA improves the IIE, we run the following ordinary least squares regression:

$$INTIE_{i,t_0-t_{-2}} = \alpha + \beta_1 S\_A_{i,t_{-3}} + \sum \beta_k CONTROLS_{i,t_0-t_{-2}} + YearFE + FirmFE + \epsilon_{i,t\_0-t\_(-2)}, \quad (1)$$

where *INTIE* as the dependent variable denotes our proxy for the IIE. *S_A*, an indicator variable that takes the value of one if a firm undergoes SA and zero otherwise, is the variable of interest. To identify *S_A,* we use the binary variable *CSR reporting external audit* from the TR Refinitiv ESG database, which indicates whether a firm has SA. Our dependent variable *INTIE* comprises insider trades over the period $year_{t-2}$ to $year_{t0}$, following Chen et al. (2018). For our variable of interest, SA, we use the lagged value of *S_A* in $year_{t-3}$[21], since the effect of SA on the

[20] Top management includes all individuals with a *rolecode1* of chairman, vice chairman, CEO, CFO, and COO. Divisional management includes individuals with a *rolecode*1 of divisional officers and officer of subsidiary and non-top executives (i.e., VP, senior VP, and other executives) whose mailing address, as shown in the insider trading filings, is not in the same state as the corporate headquarters, or is at least 500 kilometers (around 300 miles) away from the headquarters if in the same state (rolecode1 = AV, EVP, O, OP, OT, S, SVP, VP, GP, LP, M, MD, OE, TR, GM, C, CP).

[21] As an example, let us assume a firm has SA in 2012. We then compute the information distribution variable measure for 2015 using returns from insider trades from 2013 to 2015. Following Chen et al. (2018), for 2015 we also use the mean values of the control variables over the period 2013 to 2015.

IIE likely evolves with some delay.

Controls is a vector of control variables expected to influence the IIE. We base our controls mainly on Chen et al. (2018). We include firm-level measures for profitability (*ROA*), size (*SIZE*), research and development expenses (*R&D*), and future investment opportunities (*MTB*). Further, we include the standard deviation of quarterly earnings (*EARN_VOL),* as underlying volatility and inherent uncertainty affect the IIE (Dorantes et al., 2013). Since firms attributed with high complexity tend to have a poorer IIE (Dorantes et al., 2013), we control for complexity with the number of business (*NUM_SEG)* and geographical segments (*NUM_SEGGEO),* as well as a proxy for the similarity among business segments (*RELATED*). In addition, we include a firm's overall ESG performance (*ESG*) to capture its overall ESG attitude (Lee, 2017). Since external assurance is occasionally used in the literature as a dimension for reporting quality, we seek to separate the effect of scrutiny from that of quality reporting (Clarkson et al., 2011). Thus, we control whether a firm prepares its ESG report according to the Global Reporting Initiative (*GRI*) standards (Clarkson et al., 2008; Clarkson et al., 2011). Moreover, the quality of external information provided reflects the IIE. Thus, we control for analyst forecast dispersion *(ANDISP)* (Feng et al., 2009). The number of analysts reflects external pressure on companies to issue high-quality information (*ANALYST*) (Dorantes et al., 2013). On the divisional level, we include a measure for non-compete contract enforceability with the *GARMAISE* index (Garmaise, 2011) and the distance between headquarters and the sites where managers are located (*GEODIST*).[22] Further, we account for temporal events by including year-fixed effects and control for unique time-invariant firm-specific characteristics by including firm-fixed effects. If SA does improve the IIE, we expect the coefficient $\beta_1$in Eq. (1) to be positive and significant. All variables are defined as in Table 1, Panel A.

3.3 Sample Selection

We draw our sample from the intersection of the TR Refinitiv ESG database and Compustat annual files. We require that a record for the variables required be available in the TR Refinitiv ESG database. Due to the construction of our IIE measure and the resulting requirement for data availability with three lags for our SA variable, our final sample includes the period 2005–2021.[23] We initially obtain 4,260 unique firm-years. In the process of merging with the database for our measure of IIE, we lose 2,947 firm-years due to lack of data availability. Following Chen et al. (2018), we require at least three opportunistic insider trades by both headquarters managers and divisional

[22] Both variables are computed as the average values across the sites where division managers are located, obtained from the TR TFN Insider Filing Database.

[23] The first year covered by the TR Refinitiv ESG database is 2002 (i.e., 2005 is the first sample year with a three-year lag for *SA*).

managers in the previous three fiscal years in the TR TFN Insider Filing Database.[24] Further, we exclude 57 firm-years due to missing values in Compustat segments data (54 firm-years), and analyst forecast data from IBES (three firm-years). Next, we exclude financial and utility firms (244 firm-years). Lastly, we exclude 16 singleton observations. Our final sample consists of 996 firm-years from the US Table 2 summarizes the sample selection.

4. Empirical Results

4.1 Relationship between SA and the IIE

4.1.1 Descriptive Statistics

Table 3, Panel A presents descriptive statistics for our 996 firm-year observations.[25] The signed value for differences in insider trading (*DIFRET*) has a mean (median) of 0.0000 (-0.0002) with a standard deviation of 0.0092, which is smaller than the values reported by Chen et al. (2018) of -0.011 (0.002), and also shows a lower standard deviation (0.182).[26] Looking at the information distribution between headquarters and divisions, 52 percent of the observations are in favor of TM, and 48 percent in favor of divisional managers, similar to Chen et al. (2018).[27] In the presence of a reduction in the asymmetric information distribution, the difference in insider trading returns is less negative (positive) if TM (divisional management) had an information advantage beforehand. Since we are interested in effects in both directions, we focus our analysis on the unsigned (i.e., absolute) difference in insider trading returns multiplied by -1 (*INTIE*). *INTIE* exhibits a mean (median) value of -0.0061 (-0.0037). Only 29.02 percent of the firm-year observations in our sample of US firms have SA, indicating that it is still an emerging service in the US Table 3, Panel B presents pairwise Pearson correlations between the variables used in the model in Eq. (1). The

[24] From our initial 4,260 firm-year observations, we identify 2,645 firm-years with at least one match in the insider trading database (i.e., a registered insider trade within that year). Due to data constraints, we lose 49.64 percent of the firm-years. Chen et al. (2018) identify 22,487 firm-years with at least one insider trade in the respective year in their sample. After applying the constraints, they obtain 5,855 firm-year observations, which is 26.04 percent of their original sample size. We believe we lose relatively fewer observations with this sample selection step because our sample primarily consists of larger firms (due to SA data being available for mostly larger firms), for which insider trades data should be better available.

[25] We acknowledge that our sample overrepresents larger firms due to the limited availability of ESG data provided by TR Refinitiv ESG. Accordingly, our measure of size with a mean of 9.8571 is somewhat above the values reported by Chen et al. (2018) of 7.772, but similar to studies that also use ESG data (e.g., Steinmeier &Stich (2019), with a mean of 10.124 for size).

[26] We argue that this difference might be due to the overrepresentation of larger firms in our sample, to the variation in time periods (i.e., we examine 2002-2021, while Chen et al. (2018) include data from 1992-2011). It should be noted that this period, in which our datasets do not overlap, saw mainly technological developments that allowed the distribution of information to be drastically reduced, and the differences in sample sizes (i.e., 996 observations in our sample vs. 10,924 in theirs). At this point, we also acknowledge the smaller sample size of our study as an inherent limitation.

[27] They report that 50 percent of their observations are in favor of TM and 50 percent in favor of divisional managers.

magnitudes of all correlations are moderate and raise no multicollinearity concerns.

4.1.2 Baseline Results

Table 4 presents the baseline result on *whether* SA improves a firm's IIE. Column (1) (column (2)) contains regression coefficients on the model in Eq. (1) including only firm-fixed effects (firm- and year-fixed effects) (i.e., excluding control variables). The coefficient for *S_A* is positive and significant (0.0028, $p < 0.01$ (0.0020, $p < 0.05$)). Hence, a firm that undergoes SA might achieve a better IIE. Column (3) (column (4)) presents regression coefficients on the model in Eq. (1) including control variables and firm-fixed effects (year- and firm-fixed effects). The coefficient for *S_A* remains positive and significant (0.0025, $p < 0.01$ (0.0019, $p < 0.05$)), further supporting our results. In terms of economic significance, our results suggest that the SA process reduces differences in abnormal returns from insider trades between TM and business units by 31.15 percent with respect to the *INTIE* sample mean of -0.0061.[28] This is almost half the magnitude of the effect of a one standard deviation increase in R&D spending (0.0703), resulting in a 60.50 percent reduction in differences in abnormal returns from insider trading. [29] Hence, we argue that SA has a meaningful effect on a firm's IIE.

4.1.3 Addressing Potential Endogeneity Concerns

We acknowledge the fact that firms' engagement in SA might not follow a random exogenous process, as firms that engage may be systematically different from firms that do not. Hence, we apply the Heckman (1979) correction technique for such a potential non-random selection. A robust implementation requires the inclusion of exogenous independent variables in the first-stage choice model that can be validly excluded from the second-stage model (Lennox et al., 2012).

To account for this, we use media attention regarding SA as an exogenous factor influencing the decision to adopt SA (*SA_MEDIA*). Prior literature shows that media attention influences firms to engage in and report on ESG activities (Nikolaeva & Bicho, 2011).[30] We argue that the decision of a firm to adopt SA is influenced by media coverage of this specific topic, which puts external pressure on companies.[31] We utilize the logarithm of the overall number of articles related to SA included in the Factiva news database. To correct for the potential that a firm headquartered

[28] Calculated on the coefficient displayed in column (4).
[29] Calculated on the coefficient displayed in column (4).
[30] Focusing directly on media coverage of SA per se, rather than on that of individual firms helps us mitigate identification concerns as general media coverage of individual firms could be due to other factors such as managerial style or company performance (Liu et al., 2017) that do not capture SA.
[31] Additionally, we argue that media coverage of SA is unlikely to influence other determinants of the IIE.

in a state drives the counts in that state (challenging the exogeneity of the variable), for each observation we exclude the number of articles published in the state where the respective firm is headquartered. An alternative version of *SA_MEDIA* also excludes the articles published in neighboring states (*SA_MEDIA_ADJ*) to be even more conservative. We add measures for size (*SIZE*), profitability (*ROA*), investment opportunities (*MTB*), ESG performance (*ESG*), and an indicator variable for industries insensitive to environmental concerns *(I_IND)* (Casey & Grenier, 2015; Kolk & Perego, 2010; Simnett et al., 2009).[32] All variables are defined in Table 1, Panel B.

Table 5, Panel A shows the descriptive statistics of the SA determinants. Table 5, Panel B includes results of t-tests for differences in mean values of the SA determinants. The most significant t-statistics confirm our expectation that companies with SA are systematically different from those without. The results of the first stage selection model are presented in Table 5, Panel E, columns (1) and (2). Consistent with our expectations, the coefficients of the exogenous instruments (*SA_MEDIA(_ADJ))* are positive and significant in both columns ($p < 0.10$). Table 5, Panel F shows the results of the second-stage regression results (i.e., Eq. (1) including the inverse mills ratio). The coefficients on *S_A* in columns (1) and (2) show statistical significance and a similar magnitude as in our main model (0.0019, $p < 0.05$ and 0.0019, $p < 0.05$). Consequently, our results are robust to correction for a potential non-random selection.

Table 5, Panel B demonstrates that the covariates of the group of observations both with and without SA are dissimilar, as revealed by the t-statistics and corresponding p-values on *MTB*, *SIZE*, and *ESG*. Hence, we adjust for this dissimilarity using matched sample procedures to avoid biased estimates. First, we apply propensity score matching (PSM).[33] Table 5, Panel C reports the descriptive statistics of the matched sample used in the PSM. The t-statistics indicate that after the matching the means of the observations with and without SA show no significant differences. Table 5, Panel F, column (3) provides the estimated coefficients on the matched sample. The coefficient on *S_A* has the same magnitude as in the main results and is significant ($p < 0.10$). Next, we use entropy balancing (EB), a quasi-matching approach to balance our treatment (SA) and control group (without SA) (Chapman et al., 2019; Hainmueller, 2012; Johnson et al., 2023).[34] One advantage of EB is, that the full sample size is preserved. Table 5, Panel D shows the covari-

[32] Our first-stage selection model is: $Prob(SA = 1)_{i,t\_(-3)} = \alpha + \beta_1 SA\_MEDIA(\_ADJ)_{i,t\_(-5)} + \beta_2 ROA_{i,t\_(-3)} + \beta_3 MTB_{i,t\_(-3)} + \beta_4 SIZE_{i,t\_(-3)} + \beta_5 ESG_{i,t\_(-3)} + \beta_6 I\_IND_{i,t\_(-3)} + YearFE + \epsilon_{i,t\_(-3)}$.

[33] We applied one-to-one nearest neighbor matching without replacement on the determinants used in the selection model of the first stage of the Heckman (1979) correction: *ROA*, *MTB*, *SIZE*, *ESG*, *I_IND*.

[34] Entropy balancing specifies the appropriate weights for the control observations and reweights each to ensure that the post-weighting distributional properties of all covariates for the treatment (SA = 1) and control (SA = 0) observations are approximately the same, thus ensuring covariate balance (Hainmueller, 2012).

ates considering the assigned weights by the algorithm, indicating similar means and standard deviations. Table 5, Panel D, column (4) displays the results of Eq. (1) adjusting for the assigned weights. The coefficient on *S_A* shows a similar magnitude and significance level ($p < 0.05$) as in the main analysis.

4.1.4 Robustness and Sensitivity Tests

We perform several robustness and sensitivity tests (available upon request). In our main test, we calculate cumulative abnormal returns for *INTIE* from estimates of expected returns using Fama and French's (2015) five-factor model. Beyond that, we test the relationship between SA and IIE based on cumulative abnormal returns utilizing a market model, a firm-size adjusted model, the three-factor model (Fama & French, 1993), and the four-factor model (Carhart, 1997).

Second, following Chen et al. (2018) in the calculation of *DIFRET* and *INTIE*, we use the average trading profit resulting from the opportunistic insider trades of top and departmental managers during the previous two fiscal years ($year_{t0}$ to $year_{t-2}$). However, one may argue that this three-year period is somewhat arbitrary. Therefore, we also considered opportunistic insider trading during the current and the previous fiscal year ($year_{t0}$ to $year_{t-1}$) as well as only in the current fiscal year ($year_{t0}$). In both cases, we adjust the time horizons of the control variables and the time of SA engagement accordingly. Next, while calculating the values for our control variables as averages over the previous two fiscal years (i.e., the average of $year_{t0}$ to $year_{t-2}$), we test whether the SA took place in $year_{t-3}$. Moreover, consistent with the definition of the controls, we also use the average of *S_A* over the previous two years.

Next, we include 244 observations from firms in the financial and utility industries which we originally excluded from our sample selection. However, our interview evidence from three financial services firms suggests that the effects of SA on IIE should also be evident among these firms. To account for possible interference and uncertainties in the firms due to the COVID-19 pandemic, we exclude the years 2020 and 2021. In addition, we split the overall ESG score into the mean of the social and environmental pillars and the separate governance pillar to explicitly control for governance mechanisms. Throughout all these modifications, our results remain qualitatively the same and provide support for our baseline results. Lastly, a frequently discussed aspect of the SA research landscape is the heterogeneity within the provider landscape. To control for this, we include the provider type as an interaction term in our empirical model.[35] The results show no significant difference in the effect for the different types of providers.

[35] We use a dummy variable equal to one if the provider is an accounting firm, zero otherwise (data from TR ESG Refinitiv).

5. Field Study

5.1 Interview Evidence

After establishing a causal and robust link to show that SA does indeed have a significant influence on a firm's IIE, we now turn to the second half of our research question, namely, how SA in particular affects a firm's IIE. To determine the specific mechanisms of the influence of SA on the IIE, we interviewed 35 individuals in a semi-structured interview setting. For the interview structure, we followed Rowley (2012) and prepared interview guidelines around the topics of interest consisting of main and follow-up questions. To explore how the SA process affects firms' internal components, we asked open-ended questions to maintain the flow of conversation (Bryman, 2016) concerning the SA process, its outcomes, and the motivations and objectives of firms adopting it.[36] We interviewed two groups. The first consisted of 15 sustainability assurors mainly from the Big Four accounting companies (hereafter "Big Four"). We focused primarily on the Big Four in our analysis as these firms have been involved in SA from early on, have gained a significant market share, and have both accountants and non-accountants in their assurance teams (Canning et al., 2019; O'Dwyer, 2011). Our interview partners were identified via email queries explaining the context of the study and asking suitable interview partners to come forward.[37] The experience level of our interviewees varied. We interviewed a junior associate (1), senior associates (6), a manager (1), a senior manager (1), a director (1), and partners (5).[38] Their tenure ranged from one (junior) to 15 years (partner and director). The second group comprised 20 corporate representatives across different industries who were responsible for SA within their respective companies. We identified them by contacting student alums and using existing industry relationships.[39] Their tenures ranged from two (ESG reporting analyst) to 40 years (head of ESG strategy). Our interviewees represented companies in Austria, France, Germany, Italy, Japan, Spain, and the US.

Our field data initially originated from SA application in the EU, as SA as a service is more

[36] Our interview guidelines (see Appendix) centered around the following topics: the SA process in the respective company (the clients), the recommendations and implemented changes, and the impact of and motivation for performing SA. Whereas the SA process and changes were exploited in the analysis to answer our research question in an investigative approach, the motivation section of most interviews was discussed right at the beginning. There were two reasons for this. First, the literature indicates heterogeneity in SA and also in the perception of how firms use it, which we wanted to control. Furthermore, we tried to create a more relaxed and trusting environment by using these questions as icebreakers.

[37] All of the Big Four firms participated in at least one interview. Since non-Big Four audit firms have a smaller market share but are developing their SA services, we also approached second-tier audit firms to assess whether they pursue a comparable method. One agreed to be interviewed. We also contacted the main non-accounting providers on the market, none of which agreed to participate.

[38] We also interviewed a former Big Four employee who now works for a national authority and is involved with national ESG reporting and verification.

[39] We approached all companies listed in the DAX40, SP500, Nikkei 225, CAC40, FTSE MIB, and ATX where we found an English reference to SA and where we could identify a contact on LinkedIn or where we found contact details on the company website. The positive response rate of all companies contacted was just below 5 percent.

established and advanced there (KPMG, 2022). In fact, the yearly percentage of firms having SA in the EU exceeds that of other major developed economies such as the US and Japan.[40] Consequently, as providers and recipients in the EU have an extensive history with SA, we expected to gain more comprehensive insights. Next, we extended and validated our field data with interviews from the US and Japan.[41] All interviews were conducted between June 2021 and October 2022 via video call and generally lasted about 60 minutes (including on- and offboarding). All interviews (except for two) were recorded and transcribed in full.[42] Table 6 presents a summary of the interviews. In the following, we use alphanumeric codes to identify the respective source when specific quotes are presented. The letter "C" indicates company insiders ("F" denotes their employer), and "A" indicates the group of assurors ("P" denotes the provider).

5.2 Theoretical Framework and Internal Change due to SA

We utilize Laughlin's (1991) model of organizational change to provide a theoretical framework to understand how the SA process may trigger change within a company and result in a richer set of information internally. Accordingly, in analyzing the collected field data, we follow the notion that an organization consists of an amalgamation of the ***design archetype***, ***sub-systems***, and ***interpretative schemes***. The design archetype includes organizational structures, rules, processes, and routines. Sub-systems comprise all *tangible* elements such as buildings, individuals, and financials, as well as the behavior and nature of these elements. Beyond that, an individual's behavior is determined by an organization's interpretative schemes, which, like the design archetype, are of an *intangible* nature.[43] Following the understanding developed by Laughlin (1991), modifications to each of these three elements are introduced by external disturbances (e.g., SA in the context of our study).[44] Internal change, triggered externally, that affects only the design archetype or the

[40] We base this observation on all available observations in the Thomson Reuters Refinitiv ESG Database from 2002 to 2018. According to this database, the annual percentage of companies with SA in the EU (56.55 percent) exceeds that of other major developed countries such as the US (20.60 percent) and Japan (35.22 percent).

[41] Across the countries, we were able to consistently support the findings (i.e., we were able to identify the same potential mechanism of impact in the EU as in the US and Japan).

[42] Two participants preferred not to be recorded; thus, one of the interviewers took notes during the interview, prepared the transcript directly after the interview, and sent the document back to the participant for approval and clarification.

[43] An organization's interpretative schemes comprise three levels: beliefs, values, and norms (level 1); mission and purpose (level 2); and meta-rules (level 3).

[44] External shocks lead to alternative pathways of change within organizations. As we are interested in the changes introduced by the SA process, we focus on change-related outcomes and do not analyze in-depth through which pathways the changes emerge. Laughlin (1991) describes four pathways that are heterogeneous in time and across organizations and affect each of the three components differently. *Inertia* describes the condition whereby the external disturbance does not result in any change in the organization. *Rebuttal* refers to the path that only results in changes to the design archetype. However, these changes do not translate to sub-systems or interpretative schemes. Thus, in this case, sometimes a permanent transition may fail and the change is reversed after some time. *Reorientation* describes a change to design archetypes that also affects the underlying and essential sub-systems.

sub-systems on its path is referred to as first-order change (***morphostasis change***), and is likely to revert over time. By contrast, permanent change involving a transformation in interpretative schemes is classified as second-order change (***morphogenesis change***).

As shown in Figure 1, prior research findings on the effects of SA can be summarized as ***first-order changes*** (i.e., changes to the underlying ESG reporting processes but not affecting a firm's interpretative schemes). Similar to Gray et al.'s (1995) categorization, these studies suggest that SA and the assurors' requested changes are most likely to be adopted by firms that are motivated to comply with stakeholder expectations and the law. Owen et al. (2000) suggest that SA has the potential to deliver insights that help firms identify risks and mitigate their exposure to future shocks while Maroun (2020) argues that SA might unlock further strategic change potential. Recent qualitative studies exploring the nature of SA suggest that it prompts changes to ESG data reporting processes, their documentation, and related management systems as a result of assurors' recommendations (Boiral, Heras-Saizarbitoria, Brotherton, & Bernard, 2019; Channuntapipat et al., 2019; C. R. Edgley et al., 2010; Farooq & Villiers, 2019a, 2019b; O'Dwyer, 2011; O'Dwyer et al., 2011). For instance, Channuntapipat et al. (2019) argue that SA helps companies to manage their ESG activities internally. (Farooq & Villiers, 2019a) suggest that providers make recommendations regarding the implementation of ESG-related activities (for instance, volunteering schemes for employees). To explore the change potential of the SA process beyond *first-order changes*, we investigate how the SA process can affect firms' internal components that constitute the IIE (i.e., *second-order changes*).

Our data analysis involves a qualitative, interpretative approach in which the transcripts are analyzed using three sub-processes: data reduction, data display, and conclusion-drawing (O'Dwyer, 2004).[45] This yields key themes within each interview relating to SA-induced changes. Following Laughlin's (1991) framework, we structure our results in terms of tangible and intangible internal changes assigned to the organizational elements (sub-systems, the design archetype, and interpretative schemes) resulting from the SA process (see Figure 2 for a summary of the analysis).

Colonization is the change pathway boosted by a group of individuals within the company that results in changes to the design archetype, sub-systems, and interpretative schemes. The final and preferred path of change, which begins with a fundamental change in interpretive schemes freely chosen and accepted by all, is known as *Evolution.*

[45] We used the software MAXQDA for the coding of the interviews, the data reduction, and the data display.

5.3 Change to Sub-Systems

5.3.1 Technical Systems

One issue raised by nearly all assurors and insiders was the complexity of ESG data and the challenge involved in using multiple sources to generate and consolidate data manually. "It was very difficult to get the data because there are a lot of different systems included and [all the data] must be aggregated to just one single KPI. This was a lot of Excel sheets and emails" (C1).

Nine assurors stated that they had made recommendations to automate and minimize manual steps in the data collection process to reduce human error. Firm insiders indicated that the ownership of implementing systems and modifications often lies with those in charge of the data and so implementation depends on them. In this context, 13 insiders indicated that they had effectively adjusted (or were planning to adjust) the existing underlying technical systems. In some cases, they mentioned implementing new flags and fields in existing systems or, alternatively, new automation methods. In addition to adapting existing systems, some organizations were considering or planning to implement holistic solutions for ESG data:

> There was a new system implemented that finally also automated all the interfaces with other systems and that also helps us to get the data just by pressing a button. (C1)

> You're trying to pull all this together from different places. So, we ran an RFP[46] for a data warehouse. (C17)

5.3.2 Individuals' Responsibilities

In addition to system modifications, 13 insiders and 11 assurors reported there had been changes in individual responsibilities and roles. The insiders indicated that they had created new positions and assigned roles within the company responsible for ESG data. They also stated that individuals from the finance function were increasingly being assigned roles related to ESG data and reporting. For instance, one assuror reflected on a client conversation about new responsibilities: "[they said] 'If we choose somebody new, where should we find them?' And we were like, 'Choose somebody from Controlling [department].' And they did" (A10).

Another company had established a network of individuals responsible for coordinating ESG data to ensure a better flow of communication and control (influenced by the SA process), with preference given to individuals with a financial background. Consequently, our interview

[46] Request for proposal.

evidence indicates that SA introduces tangible and observable changes to the underlying sub-systems (i.e., technical systems and individuals' responsibilities).

5.4 Changes to the Design Archetype

5.4.1 Reporting Processes

Assurors, in particular, reflected on the data quality benefits that their assurance brings. "We are looking at the data, primary data collection on site level, and then we follow the trace" (A7). Twelve assurors mentioned that due to (often) manual steps, undefined responsibilities, and missing documentation, they often detected errors in the data and initiated review loops before the data was finalized.

> We often identify errors with respect to quantitative data. When we ask for the raw data and the consolidation files, there are different types of errors, just plain calculation errors, timing errors, cases where data has to be transferred manually from invoices to Excel files, wrong estimates being used, wrong extrapolation being used. (A12)

However, as well as identifying errors, an external review helps companies to harmonize and align their data collection procedures and definitions, especially in decentralized settings and organizations. "Because even when there's reporting at the group level, the location, so the entities handle it quite differently" (A3). Sixteen insiders revealed that they were generally aware of the challenges of maintaining the same level of data quality and consistency across headquarters and geographically distant locations and subsidiaries. Assurors and insiders both claimed that SA helped to flag differences in data consolidation and gathering, and ensured the consistent definition of measures. "So, sometimes these kinds of on-site visits definitely help us to identify idiosyncratic points of mismanagement" (C4).

The insiders also acknowledged that SA pushed them to develop their reporting methodologies. As a result, firms would change reporting mechanisms or come up with better estimates or more precise data points:

> All the information that we had had in the past was done to the best of our ability, but a lot of it was approximate. And so, we're only able to do so much with approximate data. And so, going through the assurance process enlightens us to see it's very important for us to start pushing harder to get the whole data. (C18)

5.4.2 Governance and Management Structures

Eleven assurors highlighted that controls within ESG data reporting processes are still only rarely

documented and never fully implemented. "Many requirements, from the control environment to the reporting processes, are coming [to light] through the assurance activities" (A3).

SA providers and insiders both stated that discussions about internal processes, implemented control systems, and modeling of governance best practices took place both during and after the SA process. Fourteen insiders revealed that they consistently attempted to improve their internal control or management systems based on the assurors' recommendations after the SA process.

> But a good assurance engagement should not just be just rubber-stamping, 'Here is the clean opinion', but should bring some insights, some discussions with the audit or assurance professional, knowing a lot of different companies and how other companies cope with the same topic, what they did after the process was completed, how they built an internal policy. (A2)

5.4.3 Communication Structures and Routines

Auditors' requirements and recommendations result primarily in tangible changes to internal controls, documentation systems, and processes. However, interviewees in both groups (eight auditors and 16 insiders) indicated that the SA process itself established additional *horizontal* communication channels and routines with the plants and subsidiaries, which provided rather more intangible insights into company operations.

> In big companies, they don't even know themselves what other […] sites and other countries do for exactly the same topic. And I feel like it benefits the company a lot because normally when we have the audit calls with sites and other countries, the central manager from [Country A] is also on this call, and suddenly learns what their [Country B] colleagues do and how they treat the data and why they do it like that and not like this. (A4)

Moreover, during the SA process, there is frequent communication between the assurance team, the individuals responsible, the departments involved, and TM. Assurors acquire firm-specific knowledge and share this with responsible individuals within the firm. In one specific example, an interviewee mentioned that this knowledge exchange extends beyond the SA engagement. SA also establishes new *vertical* communication channels, as findings are increasingly discussed with TM.

> The findings are also discussed in what we call the 'hardcore meetings', which are combined with the financial reporting audit meetings pre-year-end and with all the larger subsidiaries. At these meetings, the CFOs are also present. So, any findings would also be conveyed to a very high level at that point. (C2)

To summarize, we find evidence that SA influences more tangible reporting processes and methodologies, shapes governance structures and internal policies, and establishes new intangible communication channels, which amplifies information sharing and acquisition.

5.5 Changes to Interpretative Systems

5.5.1 Employees' Motivation and Awareness

Eleven assurors and 16 insiders acknowledged that employees with no experience in controlling and reporting, and who had never been exposed to an audit process, frequently had to provide ESG data and also interact with assurors. Thus, individuals are often unprepared and inexperienced, and work in an unstructured manner. Consequently, both parties recognized and reflected on learning effects and knowledge exchange involving data collection, processing, and control through external guidance and pressure from the assurors.

> An individual in the audit department understands what an audit professional expects from them. A sustainability expert does less because that individual might never have worked in an audit firm or similar. And therefore, these people normally have more of a learning curve, whereas it should normally be stable in the financial department. (A2)

Both assurors and firm insiders acknowledged that this learning effect sometimes occurred as a direct result of interactions with the assuror, but also indirectly via training provided based on assurors' recommendations.[47]

> If we have a company where we've done different site visits, and we've realized for every site visit something went wrong, then we would initiate a training session for the headquarter to train their staff how to properly insert the data or gather the data even before reporting it back to the headquarters. (A6)

Moreover, five assurors and seven insiders emphasized the complexity of ESG data and the time and resources required to collect and consolidate this information. In particular, understanding and questioning data in the ESG context is complex. Both assurors and firm insiders mentioned changes in the employees' attitude toward the importance of correct data. In particular, four assurors and five company insiders observed a movement toward independent questioning during data collection, triggered by questions asked during the SA process.

> It was quite difficult to get this mindset shift into these people's heads—not to focus on the story, but to focus more on the numbers. That was a quite challenging process. (C9)

[47] Four assurors and four insiders mentioned training as one recommendation and outcome of the SA process.

5.5.2 Integrated Thinking and Internal Barriers

Twelve assurors also stated that they perceived their role as that of an intermediary between the different departments of an organization, particularly in the context of translating structures from financial reporting and audit areas to ESG reporting and assurance areas.

> Sustainability people could learn from their financial colleagues how processes are implemented and what the 'four-eyes principle' is. But to be honest, the two departments are not very—not in love with each other. Because the financial guys are always thinking, "The sustainability guys' system, [their] soft KPIs, are not very important, because our steering KPIs are EBITDA and revenue", and whatever. Often, we have to connect them, as an auditor, and make them work together. (A5)

One interviewee stated that raising awareness of more accurate data during the audit process also improved communication with the finance function. "If we were only using approximate information, it's hard to really get our financial team to see the ROI as accurate" (C12). Thus, higher-quality ESG data fosters the integration of ESG into financial decision-making. While 12 assurors believed that ESG reporting could benefit from learning from the finance side, 16 insiders confessed that, for successful integration, the finance function also needed awareness and knowledge of ESG.

> They have to put in both skills [financial and ESG], because it's absolutely impossible to analyze sustainability information precisely with financial skills alone, and vice versa. (C16)

Based on the responses of ten assurors and 13 insiders, we find evidence of developments of an intangible nature in individuals' motivation and perceptions of ESG matters. We also infer support for linking and reconciling diverse perspectives and beliefs (i.e., unlocking silo structures), which was mentioned by one assuror and six insiders.

5.6 Modifications due to the SA Process and the IIE

Overall, we find evidence not only for temporary *first-order*, but also for permanent *second-order* changes related to SA, which affect all of the elements of an organization (i.e., sub-systems, the design archetype, and interpretative schemes). As organizations are information-processing structures that operate in uncertain environments (Daft & Weick, 1984; Moenaert & Souder, 1990; Thompson, 2008), the underlying IIE determines the quality of decisions undertaken by the TM (Gallemore & Labro, 2015; Goodman et al., 2014; Harp & Barnes, 2018). In this context, the IIE is formed by the accessibility, usefulness, reliability, accuracy, and quantity of the knowledge and data that is collected, generated, and consumed within an organization (Gallemore & Labro, 2015). In essence, IIE is primarily shaped by the underlying data *quality* and *scope*. Hence, we connect

the changes brought about by SA with its impacts on the IIE (i.e., information *quality* or information *scope* implications) (see Figure 2).

Concerning data *quality*, one essential aspect of the IIE is the effectiveness of the processes and controls through which information is gathered. Robust internal control environments are a crucial determinant of the quality of IIE (Dorantes et al., 2013; Feng et al., 2009; Goodman et al., 2014; Kinney, 1999). As well as technical systems and process designs, the human factor decisively shapes the IIE: Guo et al. (2016) indicate that employees' skills and personal motivation, in particular, influence how precisely they perform their tasks within reporting processes. According to Doyle et al. (2007a), the misreporting of information in an organization is due not only to poor processes, but also to unintentional errors committed by the employees responsible for reporting and executing controls. Therefore, employees must be equipped with sufficient skills and qualifications to enact controls once they are instated (Ge & McVay, 2005). In addition, those responsible for these tasks need the capabilities and motivation to perform them (Doyle et al., 2007b). Our field data suggests that SA improves the processes, documentation, and consistency of ESG data across the organization. Moreover, our findings indicate that those responsible for data collection and processing undergo a learning curve due to the SA process, which can be attributed to the transfer of knowledge and skills by the assurors interacting with them. We also obtain interview evidence that the SA process instills greater awareness of, and dedication to, the correctness of reported data.

With regard to the *scope* of information, the IIE is positively affected by newly established or re-evaluated reporting and information processes that uncover new insights and information (Cheng et al., 2018). In addition, communication routines are important to facilitate the acquisition and distribution of information. In high-uncertainty work environments, the exchange of information within teams is essential, as is communication and coordination across divisions (Lievens & Moenaert, 2000). Effective communication is an important vehicle to assist in sharing and exchanging relevant information across individuals and groups (Lievens & Moenaert, 2000). In this context, communicational effectiveness is shaped by the quality and structures of communication, which, in turn, reduce uncertainty within the organization (Jehiel, 1999; Lievens & Moenaert, 2000). Interpersonal channels, in particular, have been found to be more efficient in transmitting highly complex subject matter (Fidler & Johnson, 1984).

In addition to improvements in underlying data quality, our qualitative findings point to the introduction of new communication routines (vertical and horizontal). Moreover, the evidence suggests that the review process detects and flags up inconsistencies. The potential for unlocking silo structures is another point in favor of including ESG data in the underlying IIE. Frameworks,

such as the integrated reporting (IR) framework, highlight the importance of integrated thinking to enable integrated decision-making (IFRS Foundation, 2021).[48]

6. Additional Analysis

6.1 Reduction of Asymmetric Information for Individual Organizational Groups

The analysis of our field data suggests that the IIE improves following SA not only as a result of improvements in the quality of the underlying data, but also as a result of a wider scope of information being utilized. Specifically, this results from increased attention, improved integration, and new patterns and channels of communication. When analyzing how SA affects the IIE, it is interesting to examine where the information advantage is located before, and where it is integrated following, SA. Based on our findings in the field, we expect new vertical and horizontal communication channels to emerge:

> At that point, we also established a network of people who were to bridge that gap between the local environmental officers and finance. (C2)
>
> Ultimately, it filters up to the sustainability committee and audit committee. (C2)
>
> It was just listening, and then using it as input from our own later consolidation interviews. So, it wasn't guiding the site on what to say, it was really for informational purposes. (C6)

Moreover, changes in awareness affecting divisions or different departments and TM also evolve (i.e., horizontal communication channels):

> So, the people working in different areas, if they want to improve, they go to the auditor and say, okay, if you want to have a change in this area, you have to write it down in the management letter comments. (C9)
>
> I think there's a lot of intention now, not only in the person involved in the process, but also in the top management because we are frequently communicating the results in the group steering committee. (C1)

One of the advantages of our empirical proxy of IIE (*INTIE*) is that it allows us to test for which organizational group information asymmetry is reduced. Thus, we split our sample into two subsamples, one in which the top management (vs. divisional managers) had an information advantage prior to the SA, and one in which the divisional managers (vs. top management) had an information

[48] According to the IR framework, integrative thinking describes the active consideration by an organization of the relationships between its various operating and functional units and the capital that the organization uses or affects. Integrated thinking leads to integrated decision-making and actions that consider the creation, preservation, or erosion of value over the short, medium, and long term.

advantage.[49] Table 7 provides the results for this sample split. Column (1) (column (2)) contains regression coefficients on a subsample that includes observations with information advantage in favor of the divisional (top) management. Note that the regression coefficient on *S_A* is only significant ($p < 0.01$) on the sample in which the TM has an information advantage. Thus, our data rather suggests an information flow toward or an increased consciousness of the subsidiaries, supporting the suggestion by the field data of new horizontal communication channels rather than vertical ones.

6.2 Heterogenous Effect of SA Across Firms

6.2.1 Level of Integration

In our interviews, both assurors and insiders suggested that the extent to which the SA process could lead to tangible and intangible changes in structures of processes and thinking was dependent on certain firm-level factors. The main argument in favor of our empirical test focuses on the changes implemented due to the SA process that resulted in a better IIE. Nine assurors and 13 insiders agreed that it was both a challenge and an opportunity to transfer controls, processes, and thinking from financial reporting to ESG reporting.

> There is usually a lot of room for improvement. Professionalism in the non-financial reporting space, just as we have it for the financial space. (A2)

However, due to the heterogeneity across companies and their reference points of organizational status when they start implementing SA, it follows that the extent of improvements may vary. According to our qualitative evidence, some companies already extensively integrate ESG data within their processes and thus already foster extensive interaction with different departments across the firm, building up knowledge and establishing awareness across the workforce.[50]

> Obviously, if you're a company that is very well structured, and we don't have any improvements for your processes or controls to make, then that's fine. (A6)

Moreover, companies sometimes utilize their internal audit function for internal assurance of their ESG data, potentially mitigating the effect of external SA. Therefore, firms with low ESG integration (i.e., high ESG integration potential) ought to experience a more pronounced improvement in their IIE following the SA process. Cheng et al. (2018) show that newly introduced processes

[49] We split the sample based on *DIFRET* (i.e., the difference in insider-trade returns between the divisional and the top management). The sub-sample consisting of observations where the divisional (top) management had an information advantage consists of observations with a value of *DIFRET* larger (smaller) than zero.

[50] Also, three insiders indicated that they had already conducted internal audits of their ESG disclosures and that their SA outcomes would have been more comprehensive had these internal audits not been in place. However, one respondent also pointed out that the level of scrutiny was higher in external reviews.

largely benefit companies with fewer or poor processes.

We test this relationship empirically on our archival data. Our proxy for a company's potential to integrate new structures and learn from the SA provider is an indicator equal to a value of one if a company is below the annual median of the CSR Strategy Score of TR Refinitiv ESG, and zero otherwise. We integrate this indicator as moderator of the SA IIE relationship in Eq. (1). Table 8, column (1) presents the results. The coefficient on *SA*×*LSS* is positive and significant (0.0038, $p < 0.05$), while the main effect on *SA* is insignificance. The positive coefficient on the moderation effect is double the size of the coefficient on the main effect, suggesting that the relationship between SA and IIE is persists only in cases where firms benefit internally from the new input on structures because they have not yet implemented them to a larger extent.

6.2.2 Managerial Attention

Similarly, 11 assurors and 13 insiders stated that executive board engagement was instrumental in shaping how urgently the topic was perceived by lower-level employees. In particular, the TM is equipped with the power to deploy additional resources, which ESG departments often desperately need.

> It's not that they are unaware that there are weaknesses, it's not that they are unwilling to improve. But it's a matter of resources and a matter of whether the board members are willing to approve resources for that. (A5)
>
> But it's also a question of resources. All these steps [implementing SA provider's recommendations] require additional resources. (C2)

Also, the levels below TM have to be engaged. Ten assurors and 13 insiders mentioned that TM attention raises general awareness of allowing improvements to happen in response to SA. Thus, interviewees emphasized that, besides documented processes, companies need to create awareness for ESG data across the organization by communicating urgency and providing training.

TM attention is a critical driver of innovation (Yadav et al., 2007), including organizational change processes such as strategic changes or entry into new technology markets (Cho & Hambrick, 2006; Eggers & Kaplan, 2009). As TM has only limited attention, the appointment to the board of a dedicated individual who is responsible for ESG matters (i.e., a CSO), who can serve as an attention-carrier, will help boards to channel their attention toward ESG (Fu et al., 2020). Again, we test this potential contextual factor empirically on archival data. We use an indicator, equal to a value of one if a company has appointed a CSO to their executive board, and zero otherwise. We integrate this indicator as moderator of the SA IIE relationship in Eq. (1). Table 8, column (2) presents the results. The coefficient on *SA*×*CSO* is significantly positive (0.0047, $p <$

0.10), while the main effect remains significant and positive (0.0016, $p < 0.05$). The effect size of the moderation is substantial: the coefficient of the moderation equals 247 percent of the main effect.[51] Our archival and qualitative data suggest that TM attention toward ESG enhances the effect of the SA process on IIE, and our qualitative evidence suggests that it may place more pressure on the process itself, leading to greater awareness among individual employees, but also appointing more resources.

7. Conclusion

This paper explores how the SA process affects a firm's IIE. Using archival data, we provide evidence that SA-induced changes have measurable beneficial effects on a firm's IIE. Through interviews with SA practitioners (assurors and firm insiders), we provide novel insights into how the SA process induces organizational second-order changes in a firm's IIE. *Second-order* changes are associated with permanent internal transformation, whereas *first-order* changes are associated with transitory implementations that are likely to unravel. In particular, we learn that SA not only has the potential to influence the IIE via modifications to processes, internal controls, and governance structures (i.e., classified as *first-order* changes and also identified by prior research), but can also trigger changes to thought structures, unlock silos, and break down internal barriers (i.e., classified as *second-order* changes). In addition, SA opens up new communication channels and routines, both horizontally and vertically and alters existing ones. Moreover, SA positively affects individuals' motivation and awareness. Further additional analyses show that especially information barriers at divisional levels (i.e., vertically) are reduced. We also identify two moderators of this relationship: both the underlying level of the integration of ESG data potential and the TM's attention toward ESG positively moderate the link between SA and IIE (i.e., results in a stronger effect of SA on IIE).

By placing a strong emphasis on how SA triggers organizational change within the company, our results contribute to the literature on the effects of SA (DeFond & Zhang, 2014). In particular, based on Laughlin's (1991) framework, we indicate that SA has the potential to deliver changes beyond *first-order* changes such as design archetype changes (i.e., updated ESG reporting). Thus, we contribute new insights into the potential of SA, as we show that its outcomes can

[51] Apart from directing TM attention through the appointment of a CSO, another way to direct TM attention is the implementation of a sustainability-related compensation scheme. We test for moderation, including a dummy variable equal to one for firms that tie executive compensation to sustainability and zero otherwise (data from ESG Refinitiv). We fail to show a significant moderation effect (the main effect remains significant). This result suggests that tying compensation to sustainability is not as effective as appointing an individual to the board driving this topic. This insignificant moderation is also in line with prior literature referring to the symbolic nature of tying executive compensation to sustainability measures (Kolk and Perego, 2014).

modify all three organizational elements (i.e., tangible sub-systems, the design archetype, and intangible interpretative schemes) and result in *second-order* changes. In doing so, we provide evidence that the changes induced by SA are not limited to the ESG processes themselves (i.e., *first-order* changes, likely to reverse) and can add to the debate on the usefulness of SA (Michelon et al., 2015).

Given that previous research has only identified *first-order* changes that are less likely to lead to permanent transformation, our paper is thus relevant to investors, regulators, and, most importantly, firms, as it shows that SA can induce permanent *second-order* changes that persistently transform the organization. By elaborating on the specific actions of change, we provide additional insights for companies that already have SA and those that are mandated to adopt SA (shortly in the EU and under discussion in the US).

8. References

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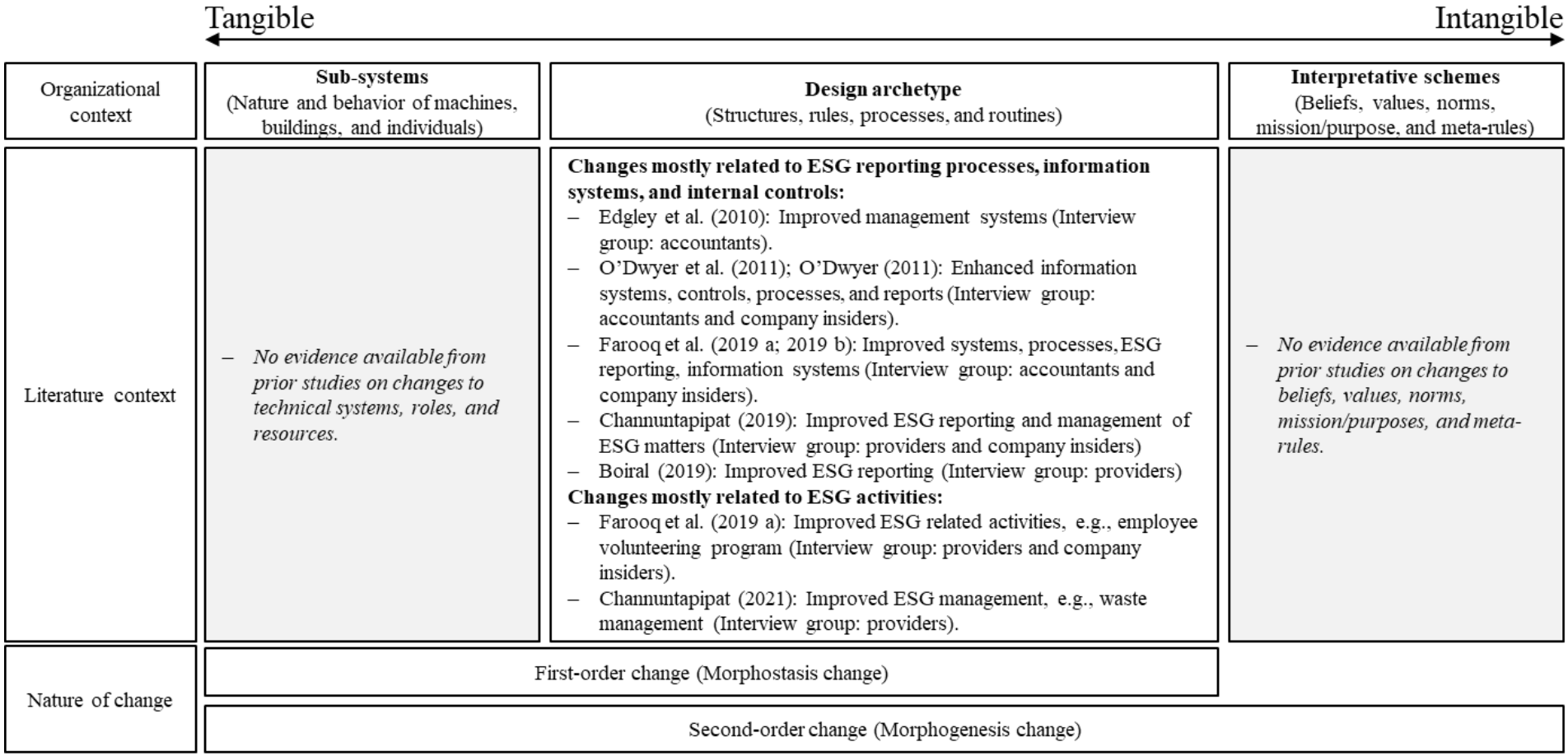
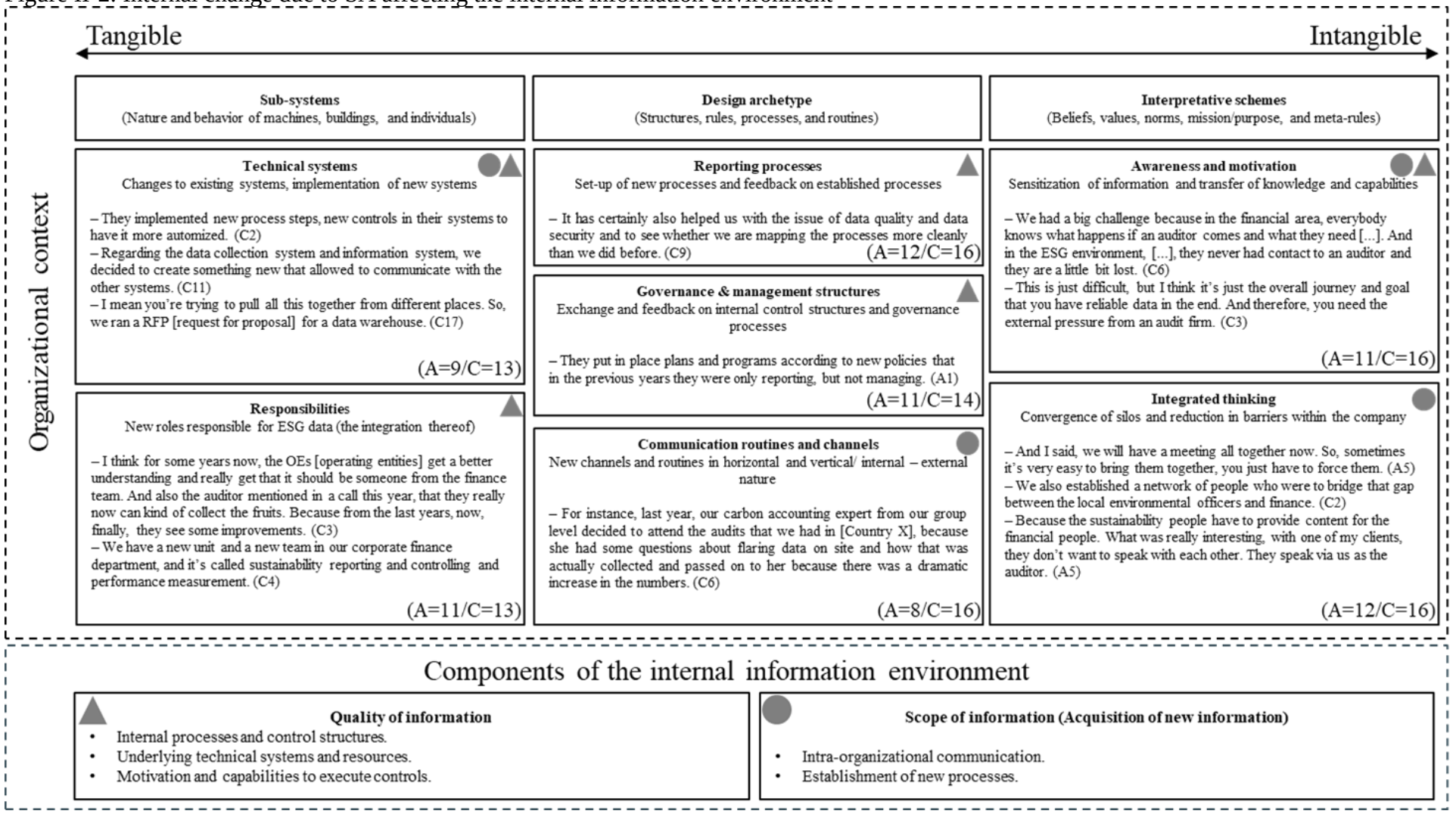
Figure II-1: Model of organizations and nature of change according to Laughlin (1991) mapped to prior studies exploring the SA process



This figure depicts Laughlin's (1991) model of organization and change in the context of SA, complemented by the findings of previous literature related to internal adjustments in the context of the SA process. When 'accountants' is indicated as the interview group, respondents include only SA providers from accounting firms. If 'providers' is specified as the interview group, the interview group consists of respondents from accounting firms (accountants) as well as consulting firms (non-accountants).

Figure II-2: Internal change due to SA affecting the internal information environment



This figure shows the changes resulting from the SA process and identified through the interviews. The changes are classified according to the organizational model, with modifications categorized as either sub-system, design archetype, or interpretative system modifications. Each of the categorized potential changes within the organizational context is mapped as either an increase in the underlying quality of information (triangle), an increase in the scope of information (circle), or both.

Table II-1: Variable definitions

Panel A: Variables for the model testing the relationship between SA and the internal information environment

S_A	Indicator variable taking the value of 1 if a company receives sustainability assurance during the period $year_{t-3,}$ 0 otherwise. (TR Refinitiv ESG)
INTIE	The absolute value of DIFRET capturing the overall asymmetric distribution of information within a company. We multiply it by -1, so higher (i.e., less negative) values represent a better internal information environment.
DIFRET	The difference between DIV_RET and TOP_RET for insiders' opportunistic trades following Chen et al. (2018).
TOP_RET	The average cumulative abnormal returns over the period of six months from the transaction date for all top executives' opportunistic open market insider trades during the period $year_{t-2}$ to $year_{t0}$. For open market sale transactions, we take the opposite sign when calculating the abnormal return. We follow Chen et al. (2018) and sort insider trades into 'routine' trades and information-based (i.e., 'opportunistic') trades. Specifically, to identify routine trades, we examine insiders' trading patterns during the entire sample period. If an insider makes open market insider trades in the same calendar month over a period of at least three consecutive years, the trades are labeled as 'routine'. For that insider, trades made in other months that do not fit the calendar pattern during the same period are labeled as 'opportunistic'.
DIV_RET	The average cumulative adjusted abnormal returns over the period of six months from the transaction date for all division managers' opportunistic open market insider trades over the period from $year_{t-2}$ to $year_{t0}$. For open market sale transactions, we take the opposite sign when calculating the abnormal returns.
ESG	Overall environmental, social, and governance score from TR Refinitiv ESG. We use the average value over the period from $year_{t-2}$ to $year_{t0}$.
GRI	Indicator variable taking the value of 1 if a company reports according to the reporting standards of the global reporting initiative (GRI), 0 otherwise. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (TR Refinitiv ESG)
GARMAISE	The average Garmaise index (Garmaise 2011) of the states for division managers. We use the updated index values from Ertimur, Rawson, Rogers, and Zechman (2018) and extend the period until 2020. The index captures enforcement stringency of non-competition employment clauses in each state. We use the average value over the period from $year_{t-2}$ to $year_{t0}$.
ROA	Return on assets ratio (Compustat items NI/AT). We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat annual file)
MTB	Market-to-book ratio (Compustat items AT + CSHO × PRCCF − CEQ − TXDB) /AT). We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat annual file)
SIZE	Natural logarithm of the market value of a firm's common equity at fiscal year-end. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat annual file)
ANALYST	The natural logarithm of 1 plus the number of analysts who issue earnings forecasts for the firm during the fiscal year. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (IBES)
ANDISP	The standard deviation of analysts' forecasts for annual EPS, divided by the absolute value of the median analyst forecast. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (IBES)
NUM_SEG	The number of business segments. We use the average value over the period from $year_{t-2}$ to $year_{t0.}$ (Compustat segments)
NUM_SEGGEO	The number of geographical segments. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat segments)

Cont. Table II-1

EARN_VOL	The standard deviation of quarterly earnings over 12 quarters ending in the current fiscal period, divided by the median quarterly asset value of these quarters. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat quarterly file)
RELATED	The ratio based on the number of related business segments, divided by the total number of business segments. The number of related segments is the difference between the total number of segments reported for a firm and the number of segments with a different main two-digit SIC code. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat segments)
R&D	The research and development expenditures (Compustat item XRD) divided by sales revenues (Compustat item SALE). We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (Compustat annual file)
GEODIST	The natural logarithm of the average geographical distance in km of the locations for divisional managers. We retrieve the addresses of the divisions to calculate geographical distances from the TFN Insider Trading database. We use the average value over the period from $year_{t-2}$ to $year_{t0}$.
Panel B: Variables employed in the endogeneity analysis	
SA_MEDIA	Logarithm of number of articles in the Factiva news database containing the key terms 'sustainability assurance', 'sustainability audit', 'CSR assurance', 'CSR audit' or references to the prominent sustainability assurance standards 'AA1000 AS', 'ISAE3000', and 'ISO 14064', as well as local applications. Before taking the logarithm, the number of articles published in the state where a firm is located is deducted.
SA_MEDIA_ADJ	Logarithm of number of articles in the Factiva news database containing the key terms 'sustainability assurance', 'sustainability audit', 'CSR assurance', 'CSR audit' or references to the prominent sustainability assurance standards 'AA1000 AS', 'ISAE3000', and 'ISO 14064', as well as local applications. Before taking the logarithm, the number of articles published in the state where a firm is located and all neighboring states is deducted.
I_IND	Indicator variable equal to 1 if a company does not rank among the industries classified as sensitive to environmental issues as classified in Villiers et al. (2011), 0 otherwise.
Panel C: Variables employed in the additional analysis	
LSS	Indicator variable taking the value of 1 if a company is below the annual median of the CSR Strategy Score of TR Refinitiv ESG, 0 otherwise. This score reflects how a company communicates that it integrates the economic (financial), social and environmental dimensions into its day-to-day decision-making processes. We use the average value over the period from $year_{t-2}$ to $year_{t0}$.
CSO	Indicator variable taking the value of 1 if a company has a chief sustainability officer appointed to its executive board, 0 otherwise. We use the average value over the period from $year_{t-2}$ to $year_{t0}$. (BoardEx)

This table presents variable definitions for the variables included in the first model (Panel A) and the endogeneity analysis (Panel B) of the analysis.

Table II-2: Sample selection for the main empirical-archival analysis

Sample selection for estimating the effect of SA on the internal information environment using firm-year observations from 2005 to 2021:		Sample reduction	# Firm-years
(1)	Firm-years covered by Compustat North America with available information on required variables from TR Refinitiv ESG in the $year_{t-3}$.		4,260
(2)	Firm-years with at least three opportunistic insider trades by both top and divisional managers over the period from $year_{t-2}$ to $year_{t0}$.	(2,947)	1,313
(3)	Firm-years with information on segments available from the Compustat segments file.	(54)	1,259
(4)	Firm-years with data on analyst forecasts available from IBES.	(3)	1,256
(5)	Firm-years after excluding financial and utility companies.	(244)	1,012
(6)	Firm-years after excluding singleton observations.	(16)	996

This table presents the sample selection procedure.

Table II-3: Testing the relationship between SA and IIE – Descriptive statistics for variables in the model

Panel A: Descriptive Statistics

VARIABLES	N	Mean	Median	S.D.	Q1	Q3
DIFRET	996	0.0000	-0.0002	0.0092	-0.0037	0.0037
INTIE (|DIFRET|)	996	-0.0061	-0.0037	0.0069	-0.0080	-0.0018
SA	996	0.2902	0.0000	0.4541	0.0000	1.0000
ROA	996	0.0816	0.0813	0.0577	0.0477	0.1219
MTB	996	2.3761	2.0373	1.3082	1.4405	2.8417
SIZE	996	9.8571	9.8561	1.3231	8.9572	10.7698
R&D	996	0.0424	0.0109	0.0703	0.0000	0.0484
EARN_VOL	996	0.0140	0.0105	0.0124	0.0066	0.0161
NUM_SEG	996	3.0100	3.0000	2.7573	0.6667	5.0000
NUM_SEGGEO	996	4.4498	4.0000	3.3074	2.0000	5.6667
RELATED	996	0.5006	0.5000	0.3859	0.0000	0.8611
GARMAISE	996	3.7731	3.5000	2.3152	3.0000	5.0000
GEODIST	996	1.3269	0.1535	2.0115	0.0000	2.2078
ESG	996	64.8403	67.4517	15.2594	55.0050	75.5417
GRI	996	0.8932	1.0000	0.2953	1.0000	1.0000
ANALYST	996	3.0278	3.0597	0.4364	2.8473	3.2942
ANDISP	996	0.0832	0.0510	0.2444	0.0279	0.0921

Panel B: Correlation Analysis

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) INTIE (|DIFRET|)															
(2) SA	0.03														
(3) ROA	**0.13**	-0.01													
(4) MTB	**0.10**	**0.12**	**0.69**												
(5) SIZE	**0.09**	**0.31**	**0.40**	**0.35**											
(6) R&D	0.03	**0.08**	**0.20**	**0.30**	**0.22**										
(7) EARN_VOL	**-0.19**	0.03	**-0.22**	-0.03	**-0.19**	**0.09**									
(8) NUM_SEG	-0.01	-0.04	-0.01	**-0.10**	**0.12**	**0.13**	-0.05								
(9) NUM_SEGGEO	**-0.14**	**0.18**	0.02	0.03	**0.11**	**0.24**	**0.16**	**0.09**							
(10) RELATED	0.03	-0.06	0.04	**0.07**	-0.03	**0.34**	0.00	**0.21**	0.05						
(11) GARMAISE	0.03	-0.03	**-0.11**	**-0.14**	**-0.13**	**-0.42**	**-0.15**	**-0.09**	**-0.18**	**-0.13**					
(12) GEODIST	**0.06**	**-0.07**	0.05	0.05	0.05	-0.04	-0.04	-0.05	0.00	**-0.07**	0.04				
(13) ESG	0.02	**0.42**	**0.08**	**0.13**	**0.45**	**0.14**	0.04	-0.05	**0.11**	**-0.13**	**-0.17**	-0.04			
(14) GRI	**0.09**	**0.21**	-0.01	0.06	**0.13**	**0.07**	0.00	**-0.13**	**0.10**	-0.05	-0.05	-0.02	**0.42**		
(15) ANALYST	0.02	**0.13**	**0.20**	**0.18**	**0.66**	**0.24**	**-0.08**	**0.13**	**0.12**	**0.07**	**-0.24**	0.02	**0.29**	0.05	
(16) ANNDISP	**-0.09**	-0.03	-0.03	-0.06	**-0.12**	0.03	**0.09**	**0.04**	**0.12**	0.01	-0.01	**-0.09**	-0.05	0.00	-0.03

Panel A presents summary statistics for variables used for the model in Eq. (1). N represents the number of unique firm-year observations included. The column 'S.D.' presents the standard deviation of each of the variables. Columns 'Q1' and 'Q3' present the 25th and 75th percentile of each of the variables. Panel B presents pairwise Pearson correlations of the variables used in the model in Eq. (1). Bold indicates significance at the 5 percent level. Detailed definitions of all variables are provided in Table 1.

Table II-4: Testing the relationship between SA and IIE

VARIABLES	(1) INTIE	(2) INTIE	(3) INTIE	(4) INTIE
S_A	0.0028***	0.0020**	0.0025***	0.0019**
	(0.0008)	(0.0008)	(0.0007)	(0.0008)
ROA			0.0108	0.0071
			(0.0089)	(0.0080)
MTB			0.0001	0.0003
			(0.0006)	(0.0005)
SIZE			0.0004	0.0005
			(0.0012)	(0.0012)
R&D			0.0488	0.0522**
			(0.0350)	(0.0230)
EARN_VOL			-0.0523	-0.0493
			(0.0374)	(0.0322)
NUM_SEG			0.0000	-0.0001
			(0.0003)	(0.0003)
NUM_SEGGEO			0.0002	0.0002
			(0.0003)	(0.0003)
RELATED			-0.0003	0.0006
			(0.0021)	(0.0018)
GARMAISE			0.0052***	0.0030*
			(0.0013)	(0.0017)
GEODIST			0.0002	0.0002
			(0.0002)	(0.0002)
ESG			-0.0000	-0.0000
			(0.0000)	(0.0000)
GRI			0.0040**	0.0027
			(0.0017)	(0.0017)
ANALYST			-0.0005	-0.0050**
			(0.0020)	(0.0020)
ANDISP			-0.0014	-0.0002
			(0.0010)	(0.0009)
INTERCEPT	-0.0069***	-0.0067***	-0.0337***	-0.0124
	(0.0002)	(0.0002)	(0.0116)	(0.0143)
Observations	996	996	996	996
Adj. R-squared	0.2581	0.3282	0.2788	0.3436
Firm FE	YES	YES	YES	YES
Year FE	NO	YES	NO	YES

This table presents the results from the model presented in Eq. (1). Detailed definitions of all variables are provided in Table 1. Standard errors are clustered at firm level and presented in parentheses below the regression coefficients. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

Table II-5*:* Testing the relationship between SA and IIE – Endogeneity analysis

Panel A: Descriptive statistics for the variables used in the Endogeneity analysis

	N	Mean	Median	S.D.	Q1	Q3
SA_MEDIA	993	6.6217	7.0049	1.0750	5.7071	7.4466
SA_MEDIA_ADJ	993	6.5241	6.9108	1.0773	5.6664	7.3454
ROA	993	0.0831	0.0789	0.0724	0.0485	0.1198
MTB	993	2.3001	2.0134	1.2397	1.4410	2.7550
SIZE	993	9.6654	9.6383	1.3579	8.6914	10.5846
ESG	993	57.3015	61.8000	21.6937	44.5000	73.5300
I_IND	993	0.8640	1.0000	0.3429	1.0000	1.0000

Panel B: Descriptive statistics for the variables used in the Heckman (1979) correction

VARIABLES	SA (N=291)	Non-SA (N=702)	t-statistic	p-value
SA_MEDIA	7.2028	6.3808	11.6946***	0.0000
SA_MEDIA_ADJ	7.1124	6.2802	11.8307***	0.0000
ROA	0.0810	0.0840	-0.5798	0.5622
MTB	2.4696	2.2298	2.7843	0.0055
SIZE	10.3407	9.3854	10.6470***	0.0000
ESG	72.4171	51.0356	15.8117***	0.0000
I_IND	0.8488	0.8704	-0.9023	0.3671

Panel C: Descriptive statistics for the matched sample analysis (PSM)

VARIABLES	SA (N=290)	Non-SA (N=250)	t-statistic	p-value
ROA	0.0829	0.0890	-1.0597	0.2897
MTB	2.4740	2.4540	0.1774	0.8593
SIZE	10.3449	10.2284	1.1056	0.2694
ESG	72.3969	71.8274	0.6258	0.5317
I_IND	0.8517	0.8560	-0.1399	0.8888

Panel D: Descriptive statistics after the entropy score weighting (ESW)

	SA (291)		Non-SA (702)	
	Mean	S.D.	Mean	S.D.
ROA	0.0811	0.0702	0.0809	0.0702
MTB	2.4739	1.4585	2.4693	1.4572
SIZE	10.3490	1.2167	10.3290	1.2158
ESG	72.4560	12.1953	72.3160	12.1881
I_IND	0.8488	0.3589	0.8483	0.3590

Panel E: First-stage for Heckman (1979) correction

VARIABLES	(1) SA	(2) SA
SA_MEDIA	**1.9972***	
	(1.1325)	
SA_MEDIA_ADJ		**1.1650***
		(0.6291)
ROA	-2.5426**	-2.5068**
	(1.0768)	(1.0647)
MTB	0.0234	0.0263
	(0.0554)	(0.0555)
SIZE	0.2445***	0.2425***
	(0.0498)	(0.0494)
ESG	0.0342***	0.0333***
	(0.0042)	(0.0042)
I_IND	-0.2825*	-0.2995**
	(0.1465)	(0.1476)
INTERCEPT	-12.8992***	-9.3015***
	(4.7977)	(2.6550)
Observations	993	993
(pseudo) R-squared	0.3320	0.3320
Year FE	YES	YES

Cont. Table II-5

Panel F: Relationship between SA and IIE

VARIABLES	(1) INTIE	(2) INTIE	(3) INTIE	(4) INTIE
SA	**0.0019****	**0.0019****	**0.0019***	**0.0022****
	(0.0009)	**(0.0009)**	**(0.0011)**	**(0.0010)**
ROA	0.0072	0.0072	0.0213	0.0090
	(0.0118)	(0.0118)	(0.0141)	(0.0118)
MTB	0.0005	0.0005	-0.0000	0.0000
	(0.0005)	(0.0005)	(0.0007)	(0.0007)
SIZE	0.0003	0.0004	-0.0001	0.0020
	(0.0015)	(0.0015)	(0.0020)	(0.0015)
R&D	0.0482**	0.0480**	0.0586**	0.0314
	(0.0234)	(0.0234)	(0.0283)	(0.0294)
EARN_VOL	-0.0500	-0.0498	-0.1043**	-0.0742**
	(0.0356)	(0.0356)	(0.0454)	(0.0339)
NUM_SEG	-0.0002	-0.0002	-0.0003	-0.0006
	(0.0003)	(0.0003)	(0.0006)	(0.0005)
NUM_SEGGEO	0.0002	0.0002	-0.0001	-0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
RELATED	0.0009	0.0009	0.0034	0.0030
	(0.0016)	(0.0016)	(0.0027)	(0.0025)
GARMAISE	0.0029	0.0029	0.0022	0.0048**
	(0.0023)	(0.0023)	(0.0021)	(0.0019)
GEODIST	0.0002	0.0002	0.0005**	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ESG	-0.0000	-0.0000	-0.0000	-0.0001
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
GRI	0.0032*	0.0032*	0.0017	0.0053**
	(0.0017)	(0.0017)	(0.0024)	(0.0022)
ANALYST	-0.0045***	-0.0044***	-0.0042	-0.0069**
	(0.0016)	(0.0016)	(0.0034)	(0.0029)
ANDISP	-0.0002	-0.0002	0.0004	-0.0004
	(0.0016)	(0.0016)	(0.0013)	(0.0008)
INTERCEPT	-0.0142	-0.0154	-0.0033	-0.0240
	(0.0195)	(0.0196)	(0.0221)	(0.0179)
Observations	993	993	520	993
Adj. R-squared	0.3426	0.3433	0.6208	0.6703
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Inverse Mills Ratio (with SA_MEDIA)	YES	NO	NO	NO
Inverse Mills Ratio (with SA_ME-	NO	YES	NO	NO
Matched Sample	NO	NO	YES	NO
Entropy Score Ba-	NO	NO	NO	YES

This table presents the results of the endogeneity analysis. Panel A contains descriptive statistics of the variables employed in the endogeneity analysis. Panel B includes two-sample t-tests on the differences in the means of the determinants of SA identified in the field data and by earlier literature. The 'SA' column includes observations of firm-years that have SA. The 'non-SA' column contains observations of firm-years that do not have SA. N represents the number of unique firm-year observations included. We report t-statistics and corresponding p-values. Panel C shows two-sample t-test on the differences in means of the determinants used in a matched sample analysis. Panel D shows means and standard deviations by analytical weights, obtained via entropy score balancing. Panel E shows the results of the first-stage model (probit regression of the Heckman's (1979) correction approach). Since the value of SA in t-3 is used in Eq. (1), the determinants are also all taken from year t-3. As a result, our sample is reduced by three observations. Panel F columns (1) and (2) contains the results of the second-stage estimation using the Heckman (1979) correction approach (i.e., Eq. (1) including the inverse mills ratio). Column (3) includes estimated coefficients on a matched sample. Column (4) includes the results of an entropy score balanced approach. Standard errors are clustered at firm level and presented in parentheses. Detailed definitions of all variables are provided in Table 1. ***, **, and * indicate significance at the 1, 5, and 10 percent level, respectively.

Table II-6 :List of interview evidence

Panel A: Interviews with SA assurors

No.	Company	Interviewee	Level	Date	Duration (in mins)
1	P1	A1	Partner	06/14/2021	50
2	P2	A2	Senior Manager	06/24/2021	51
3	P3	A3	Senior Associate	06/23/2021	38
4	P3	A4	Associate	07/07/2021	43
5	P3	A5	Director	07/07/2021	48
6	P3	A6	Senior Associate	07/14/2021	48
7	P3	A7	Senior Associate	07/20/2021	51
8	P1	A8	Manager	09/20/2021	49
9	P1	A9	Senior Associate	09/16/2021	45
10	P4	A10	Senior Associate	10/29/2021	52
11	P5	A11	Partner	11/11/2021	50
12	P2	A12	Senior Associate	12/22/2021	60
13	P3	A13	Partner	10/19/2022	45
14	P3	A14	Partner	10/19/2022	45
15	(Former P2)	A15	Expert	10/19/2022	45

Panel B: Interviews with corporate insiders

No.	Company	Interviewee	Position	Date	Duration (in mins)
1	F1	C1	Sustainability Management	10/22/2021	52
2	F2	C2	Financial & Regulatory Reporting	11/03/2021	42
3	F2	C3	Sustainability Reporting	11/03/2021	44
4	F3	C4	Sustainability Strategy	11/04/2021	50
5	F4	C5	Sustainability Reporting	11/04/2021	43
6	F5	C6	Sustainability Reporting	11/05/2021	30
7	F5	C7	Sustainability Reporting	11/05/2021	30
8	F6	C8	Sustainability Reporting	11/05/2021	42
9	F7	C9	Sustainability Reporting	11/09/2021	54
10	F7	C10	Sustainability Reporting	11/09/2021	54
11	F7	C11	Financial Reporting	11/09/2021	54
12	F8	C12	Sustainability Management	11/09/2021	47
13	F9	C13	Sustainability	11/10/2021	45
14	F2	C14	Sustainability Reporting	11/16/2021	41
15	F10	C15	Energy & Environment	11/19/2021	33
16	F11	C16	Sustainability Planning and Performance Management	11/22/2021	54
17	F12	C17	Sustainability Management	03/10/2022	50
18	F13	C18	Sustainability Management	03/25/2022	45
19	F14	C19	Sustainability Management	10/04/2022	60
20	F15	C20	Sustainability Management	10/05/2022	60

This table lists the interviewees and provides details on the interviews. Panel A (Panel B) provides details for the SA assurors (company insider) using anonymous code names for both the company and the interviewee. We refer to these code names when discussing the interview evidence in our analysis.

Table II-7: Testing the direction of flow of information – Vertical vs. horizontal

	(1) INTIE (DIFRET >0)	(2) INTIE (DIFRET < 0)
SA	**0.0022**	**0.0030*** **
	(0.0023)	**(0.0009)**
ROA	0.0094	0.0154*
	(0.0119)	(0.0093)
MTB	0.0001	-0.0006
	(0.0006)	(0.0006)
SIZE	0.0020	0.0025*
	(0.0016)	(0.0014)
R&D	0.0927**	0.0039
	(0.0399)	(0.0149)
EARN_VOL	0.0965	-0.0891***
	(0.0589)	(0.0305)
NUM_SEG	-0.0005	0.0006
	(0.0004)	(0.0005)
NUM_SEGGEO	0.0002	0.0004
	(0.0003)	(0.0004)
RELATED	0.0013	0.0011
	(0.0020)	(0.0022)
GARMAISE	0.0026	0.0036
	(0.0027)	(0.0028)
GEODIST	0.0002	0.0006***
	(0.0002)	(0.0002)
ESG	-0.0001	0.0000
	(0.0001)	(0.0000)
GRI	-0.0009	0.0018
	(0.0028)	(0.0027)
ANALYST	-0.0091***	-0.0031
	(0.0030)	(0.0020)
ANDISP	-0.0010	0.0032**
	(0.0010)	(0.0014)
INTERCEPT	-0.0097	-0.0418**
	(0.0216)	(0.0201)
Observations	460	503
Adj. R-squared	0.4237	0.5020
Year FE	YES	YES
Firm FE	YES	YES

This table presents the results from the model presented in Eq. (1). Column (1) contains coefficients on the full sample. Column (2) contains coefficients estimated on all observations with a value of *DIFRET* larger than zero (i.e., where the information advantage lies by the divisional management). Column (3) contains coefficients estimated on all observations with a value of *DIFRET* smaller than zero (i.e., where the information advantage lies with the top management). Detailed definitions of all variables are provided in Table 1. Standard errors are clustered at firm level and presented in parentheses below the regression coefficients. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

Table II-8: Testing contextual factors of the relationship between SA and IIE

VARIABLES	(1) INTIE	(2) INTIE
SA	**0.0009**	**0.0016****
	(0.0009)	**(0.0008)**
LSS	-0.0003	
	(0.0011)	
SA x LSS	**0.0038****	
	(0.0018)	
CSO		-0.0027
		(0.0020)
SA x CSO		**0.0047***
		(0.0025)
ROA	0.0084	0.0070
	(0.0082)	(0.0081)
MTB	0.0003	0.0004
	(0.0005)	(0.0005)
SIZE	0.0004	0.0006
	(0.0012)	(0.0012)
R&D	0.0548**	0.0537**
	(0.0248)	(0.0235)
EARN_VOL	-0.0489	-0.0426
	(0.0332)	(0.0323)
NUM_SEG	-0.0001	-0.0001
	(0.0003)	(0.0003)
NUM_SEGGEO	0.0002	0.0002
	(0.0003)	(0.0003)
RELATED	0.0005	0.0005
	(0.0018)	(0.0018)
GARMAISE	0.0031*	0.0039**
	(0.0018)	(0.0019)
GEODIST	0.0002	0.0002
	(0.0002)	(0.0002)
ESG	-0.0000	-0.0000
	(0.0000)	(0.0000)
GRI	0.0024	0.0028
	(0.0016)	(0.0017)
ANALYST	-0.0048**	-0.0051**
	(0.0020)	(0.0020)
ANDISP	-0.0000	-0.0000
	(0.0015)	(0.0015)
INTERCEPT	-0.0120	-0.0168
	(0.0137)	(0.0138)
Observations	996	996
Adjusted R-squared	0.3474	0.3451
Firm FE	YES	YES
Year FE	YES	YES

This table presents the results from the model presented in Eq. (1) including moderation. Column (2) includes an interaction term with *LLS* as an indicator taking the value of 1 if a company is below the annual median of the CSR Strategy Score of TR Refinitiv ESG, 0 otherwise. Column (3) includes an interaction term with *CSO* as an indicator variable taking the value of 1 if a company has a chief sustainability officer appointed to its executive board, and zero otherwise. Detailed definitions of all variables are provided in Table 1. Standard errors are clustered at firm level and presented in parentheses below the regression coefficients. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

9. Appendix: Research Instrument

9.1 Guidelines for Interviews with Sustainability Assurance Assurors

9.1.1 Explanatory Remarks

These interview guidelines represent the version used during the interviews with sustainability assurors. We focused on asking open-ended questions to encourage interviewees to be open about their experience of providing sustainability assurance (SA). For each topic, questions were framed around a *who?/what?/why?* structure. As the interview process was semi-structured, the interview questions were not asked strictly in the same order in all interviews. For many questions, we asked interviewees to provide examples from their practice.

9.1.2 Interview Start

- Introducing interviewees to the broad topic of the research project and the researchers conducting the interview
- Instructions/information on the general interview procedure

9.1.3 Interview Questions

9.1.3.1 Theme 1: Objectives and nature of the SA process (asked at the beginning of each interview)

Objective: To understand assurors' perception of SA. Example questions:

- In your view, what is the key purpose of SA?
- Why have your clients adopted SA?
- How do you set the level and scope of assurance with your client?
- What factors influence the scope and level of assurance?

9.1.3.2 Theme 2: The process of (initiating) SA

Objective: To understand the SA (adoption) process from an assuror's perspective. Example questions:

- What are the main steps before companies embark on their first SA engagement?
- What elements are involved in a pre-study or readiness assessment?
    - *Potential follow-up question:*

      Why do your clients decide to use such a service?
- What key steps and timelines are followed when companies receive SA initially/yearly?
    - *Potential follow-up question:*

      How is the internal project team set up?
    - *Potential follow-up question:*

      Which internal stakeholders are involved?

- *Potential follow-up question:*

  How do stakeholders respond to the SA project?
- *Potential follow-up question:*

  Which departments are involved, and where in the hierarchy are their representatives?
- *Potential follow-up question:*

  How are the different sites involved in the process?
- *Potential follow-up question:*

  How do the contact persons/stakeholders/sites involved in the SA process communicate?
- *Potential follow-up question:*

  What is the feedback from the individuals/sites involved?

9.1.3.3 Theme 3: Internal effects of SA on sustainability-related reporting

Objective: To understand the changes induced by (the adoption of) SA. Example questions:

- What role does the analysis of internal controls and processes play in the initial/yearly SA engagements?
  - *Potential follow-up question:*

    What key parts of the internal control systems and reporting processes do you focus on?
- How do you approach your clients if you identify weaknesses in internal controls, processes, or documentation?
- What actions do your clients take to address these weaknesses?
  - *Potential follow-up question:*

    At what point in the timeline are these actions implemented?
- What is your role while your client is implementing the requested changes?
- What are the potential impacts of the SA process on firm-level sustainability reporting?
  - *Potential follow-up question:*

    Why do these potential consequences materialize/not materialize?

9.1.3.4 Theme 4: Internal effects of SA beyond sustainability-related reporting

Objective: To understand the changes induced by (the adoption of) SA. Example questions:

- Since much of the data used for sustainability reporting come from operational processes, what role is played by the analysis of internal controls and processes associated

with operational processes (production, logistics, HR, SG&A) as part of the initial/yearly SA engagements?

- *Potential follow-up question:*

  What key processes do you focus on? And why do you focus on these processes?

- How do you approach your client if you identify weaknesses associated with these processes?
- What actions do your clients take to address these weaknesses?
  - *Potential follow-up question:*

    At what point in the timeline are these actions implemented?
- What is your role while your client is implementing requested changes?
- What potential consequences result from the modifications to these operational processes?
  - *Potential follow-up question:*

    Why do these potential consequences materialize or not materialize?

9.1.3.5 Theme 5: Evolution of SA within a company

Objective: To understand the difference between initial and consecutive SA engagements at one client. Example questions:

- What are the differences between consecutive SA engagement (in the subsequent years) and initial SA engagement?
- What is the difference between the effort necessary to perform an initial SA engagement and the effort necessary to perform an engagement in which there is a transition from a limited to a reasonable assurance level?
- What specific tasks do you perform for a reasonable assurance engagement level but not for a limited assurance level engagement?

9.1.3.6 Final question: Current developments (asked at the end of each interview)

- What is your opinion on mandating SA?

9.2 Guidelines for Interviews with Company Representatives (Firm Insiders)

9.2.1 Explanatory Remarks

These interview guidelines represent the version used in interviews with company representatives (firm insiders). We focused on asking open-ended questions throughout the interviews to encourage interviewees to be open about their experience of receiving SA. For each topic,

questions were framed around a *who?/what?/why?* structure. As the interview process was semi-structured, the interview questions were not asked strictly in the same order in all interviews. For many questions, we asked interviewees to provide examples from their practice.

9.2.2 Interview Start

- Introducing the interviewees to the broad topic of the research project and the researchers conducting the interview
- Instructions/information on the general interview procedure

9.2.3 Interview Questions

9.2.3.1 Theme 1: The process of initiating SA – Objectives and nature

Objective: To understand the perception of SA from a firm insider's perspective. Example questions:

- What is your role in the company and how is it linked to sustainability-related data and SA?
- In your view, what is the key purpose of SA?
- Why did your company decide to adopt SA?
- Why have you chosen your current level of assurance (limited/reasonable)?
    - *Potential follow-up question (if the company has chosen a limited assurance level)*

      Have you ever internally discussed increasing the level of assurance to reasonable ?
    - *Potential follow-up question (if the company has chosen a limited assurance level):*

      Why was that discussion initiated?
    - *Potential follow-up question (if the company has chosen a limited assurance level):*

      What was the outcome of that discussion?

9.2.3.2 Theme 2: The process of (initiating) SA

Objective: To understand the practical procedure of the SA (adoption) process from a firm insider's perspective. Example questions:

- What steps were taken when your company received SA for the first time?
- What preliminary study or readiness assessment did you conduct before the first SA engagement?
    - *Potential follow-up question:*

Why did you choose that option?

- What were (are) the key elements and the timeline when your company initially received/yearly receives SA?
    - *Potential follow-up question:*
      How was (is) your company's internal project team set up?
    - *Potential follow-up question:*
      Which stakeholders were (are) involved internally?
    - *Potential follow-up question:*
      How did (do) the stakeholders respond to the SA project?
    - *Potential follow-up question:*
      Which representatives at what level of the various departments were (are) involved?
    - *Potential follow-up question:*
      How were (are) the different sites involved in the process?
    - *Potential follow-up question:*
      How did (do) the SA provider/stakeholders/sites involved in the SA process communicate?
    - *Potential follow-up question:*
      What was (is) the feedback from the individuals/sites involved?

9.2.3.3 Theme 3: Internal effects of SA on sustainability-related reporting

Objective: To understand the changes inducd by (the adoption of) SA. Example questions:

- What role is played by the analysis of internal controls and processes in the initial (yearly) SA engagements?
    - *Potential follow-up question:*
      What key parts did (does) the SA provider focus(ed) on?
    - *Potential follow-up question:*
      How did (does) the SA provider evaluate the processes and controls?
    - *Potential follow-up question:*
      Who was (is) involved in the analysis of internal controls and processes on your company's side?
    - *Potential follow-up question:*
      How were (are) subsidiaries and production sites involved in the analysis of internal controls and processes?

- How did (does) the SA provider share the results of the analysis of internal controls and processes with you?
    - *Potential follow-up question:*
      How did (do) you discuss the identified topics internally?
    - *Potential follow-up question:*
      Who was (is) involved in that internal discussion? And why?
- What changes did (do) you implement based on the discussed topics and results of the SA process? And why did (are) you implement(ing) these changes?
    - *Potential follow-up question:*
      ...relating to your internal control system?
    - *Potential follow-up question:*
      ...relating to your technical systems?
    - *Potential follow-up question:*
      ...relating to documentation and responsibilities?
    - *Potential follow-up question:*
      At what point in the timeline are these actions implemented?
- What are the impacts of the SA process on your sustainability reporting?

9.2.3.4 Theme 4: Internal effects of SA beyond sustainability-related reporting

Objective: To understand the changes induced by (the adoption of) SA. Example questions:

- What role was (is) played by the analysis of internal controls and processes related to operational processes (production, logistics, HR, SG&A related) as part of the initial/yearly SA engagement?
    - *Potential follow-up question:*
      What key parts did (does) the SA provider focus on?
    - *Potential follow-up question:*
      How did (does) the SA provider evaluate the processes and controls?
    - *Potential follow-up question:*
      Who was (is) involved in that element of the SA process (i.e., the analysis of internal controls and processes) on your company's side?
    - *Potential follow-up question:*
      How were (are) subsidiaries and production sites involved in that element of the SA process (i.e., the analysis of internal controls and processes)?

- How did (does) the SA provider share the results of the analysis of internal controls and processes with you?
    - *Potential follow-up question:*

      How did (do) you discuss the identified topics internally?
    - *Potential follow-up question:*

      Who was (is) involved in that internal discussion? And why?
- What changes did you implement based on the discussed topics and results of the SA process?
    - *Potential follow-up question:*

      At what point in the timeline were these actions implemented?
- What are the impacts, if any, of the SA process on your operational processes?

9.2.3.5 Theme 5: Evolution of SA within a company

Objective: To understand the difference between initial and subsequent SA engagements at firm level. Example questions:

- How did the initial SA engagement differ from subsequent SA engagements?
- How did the SA process develop and evolve over the years within your company?
    - *Potential follow-up question:*

      Why did it develop?
    - *Potential follow-up question:*

      What are the potential drivers?
- What were the key elements/challenges in moving from a limited to a reasonable assurance level?

9.2.3.6 Final question: Current developments (asked at the end of each interview)

- What is your opinion on mandating SA

Part III: Sustainability Assurance and Resource Adjustments: The Case of Cost Asymmetry

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1. Introduction

"Most companies don't actually produce CO2 [carbon dioxide]; they burn something that produces CO2, which means if you reduce your CO2, you reduce the stuff that you're burning, or that you're using, which means it's a cost saver too" (Interview with Assuror 10)

Between 2005 and 2022, the percentage of the world's 250 largest companies that received external assurance on their environmental, social, and governance (ESG) disclosure (hereafter sustainability assurance (SA)), more than doubled (30 percent in 2005 vs. 63 percent in 2022) (KPMG, 2022). Within the relationship of SA providers, users, and the company receiving SA, most research to date has focused on the effect of SA on users and how practitioners construct SA (O'Dwyer et al., 2011; Reimsbach et al., 2018; Simnett et al., 2009). In this study, we suggest a novel yet unresearched potential firm-internal effect channel of SA by focusing on the receiving firm in SA engagements, examining specifically whether receiving firms gain information regarding operations and systems and use this information in resource allocation. Our research approach follows the call of Soltes (2014) and combines field data with archival data.[52]

Arif et al. (2022) indicate that firm insiders gain private information from the financial audit process. However, ESG disclosure and SA significantly differ from financial reporting and audit as they are voluntary and non-systematic. Given that material ESG issues for a company may change from year to year depending on internal and external factors, the comprehensiveness of the ESG disclosures and the SA are not predetermined and may change significantly, too (Canning et al., 2019; Farooq & Villiers, 2019; O'Dwyer, 2011).[53] Moreover, the maturity of ESG reporting also differs from that of financial reporting (O'Dwyer, 2011). The nascency of reporting structures and systems and the complexity of ESG indicators pose challenges to both companies and SA providers (O'Dwyer, 2011). Nevertheless, Maso et al. (2020) contend that SA providers, who are also entitled to financial audit engagement, benefit from SA engagements by gaining additional information on internal systems, processes, and operations. They in turn leverage this information in their financial audit opinions. We similarly argue that SA may produce complementary information that enhances managerial understanding

[52] Soltes (2014) emphasizes that it is particularly important to consider multiple data sources when attempting to answer research questions. Accounting scholars often limit their research to archival data sources when investigating phenomena. Moreover, Soltes (2014) highlights that it is fruitful to supplement archival data with field data because it provides a unique opportunity to deepen researchers' ability to investigate phenomena of interest. Thus, field data that complement archival data is one additional important source of data for developing hypotheses and supporting conclusions. For similar approaches to combine archival and field data, see Bushee and Miller (2012) and Bills et al. (2020).

[53] "This [ESG reporting] is a living organism that is growing and thriving. That also shows itself. It's never complete, and it can't be." (C 13).

of processes and operations, thus influencing decisions on the adjustment of processes and operations. For example, emissions can be linked to energy-intensive production facilities; travel expenses are not only closely related to emissions, but also to economic choices.[54]

Prior studies often analyze the content of publicly available SA opinions (e.g., O'Dwyer & Owen, 2005). However, SA opinions are limited, not comprehensive, and selective (Boiral et al., 2019). Thus, following prior studies (e.g., O'Dwyer, 2011), we collect field data by interviewing 35 individuals consisting of SA assurors and corporate individuals responsible for the SA process to gain additional insights into the SA process. We structure our interviews around key SA topics, evolving changes in ESG-related reporting processes, and underlying operational processes: e.g., how SA providers approach clients when they detect inconsistencies in ESG data and reporting processes; how individuals interact with SA providers and deal with their recommendations and comments internally; and what role providers play in the implementation of recommendations. Additionally, we asked for motivation and perceptions of SA, to capture how companies evaluate SA. These insights help motivate and enhance our identification strategy (i.e., identifying control variables such as underlying ESG reporting environment, or financial reporting quality) including our Heckman selection model (i.e., external pressure on companies to adopt SA).

Considering a service perspective of the assurance process introduced by Knechel et al. (2020), we analyze the field data throughout the SA process.[55] Accordingly, we expect one output of SA to be advice to management on how to achieve operational objectives, which implies indirect rather than direct effect channels of SA.[56] In the field data, we identify indirect channels by which companies receive additional information about their operations and the resources they commit from primarily advisory elements in the SA process. Beyond that, evidence suggests enabling effects for incorporating ESG indicators as complementarities for man-

[54] "We steer certain decisions regarding travel or where we source our energy from." (C 2).

[55] Providers may be inclined to use "speak up" as a marketing strategy and insiders may be cautious about admitting ESG reporting issues, so we matched provider and insider statements. In general, having mapped the quotes, we could not find that one or the other party was making contradictory arguments. Rather, we find that for some items, insiders (or assurors) were more involved than the other party and could hence provide more in-depth insights. For instance, insiders are more involved in what happens after SA, whereas SA assurers are more involved in the operational SA work than an individual in the company who is responsible for the entire SA process. This is because data responsibility for non-financial issues often lies with the individual departments and due to limited resources, SA assurors often interact directly with the company individuals responsible for one data item. Moreover, SA assurors often provided us unprompted with examples to support their statements. Where they made general statements, we asked for specific examples, e.g., from SA providers for explicit recommendations for their clients and from company representatives for implementation examples and specific projects that emerged due to the SA process.

[56] Given these prior observations, we structured our interview questions around the SA process and potential impacts to identify potential (indirect) impact channels.

agerial decision-making. We integrate these findings into developing intuition for our hypothesis to strengthen our understanding of SA (Bills et al., 2020; Soltes, 2014).

To estimate the relationship between SA and managerial decisions related to committed resources empirically, we utilize the concept of *asymmetric cost behavior*. Departing from the traditional view of resource consumption, consisting of fixed and variable resources (Cooper & Kaplan, 1992), Anderson et al. (2003) argue that most resources are neither fixed nor variable; rather, they are not continuously adjustable in response to changes in activity levels and are associated with start-up and replacement costs (i.e., hiring and layoff expenses). Because of these *sticky resources*, managers postpone adjustments to committed resources when output levels suddenly decline because of uncertainty regarding the development of demand and required resources.

While the under-adjustment of resources in the event of a decline in activity levels (i.e., *cost stickiness*) can be, to some extent, beneficial in avoiding costly future installment and reemployment costs (Anderson et al., 2003), internal inefficiencies cause deviations from optimal adjustment levels (Chen et al., 2012). These arise due to internal agency conflicts or a lack of timely internal information for managers, preventing adjustments of committed resources (Chen et al., 2012; Kim et al., 2019). In this context, firms may face internal ambiguity about their resource consumption (Antle & Bogetoft, 2018). As our field data suggest that SA could deliver additional information on operations and resources, we hypothesize that SA results in additional insights that help managers adjust their resources to a greater extent, resulting in less under-adjustment of resources (i.e., less cost stickiness). As the beneficial and harmful fractions of delays in resource adjustments are poorly understood (Banker & Byzalov, 2014), we further argue that SA reduces internal inefficiencies causing under-adjustment of resources. We hence hypothesize that decisions related to resource adjustments attributable to SA enables firms to reduce a harmful fraction of cost stickiness, potentially benefiting firm value.

We use a cross-country setting to test our hypothesis since SA is a worldwide phenomenon and the US market for SA lags (Casey & Grenier, 2015; KPMG, 2022). Our sample consists of all available observations at the intersection between Compustat (Global and North America) and Thomson Reuters Refinitiv ESG, resulting in 6,320 observations from 40 countries covering 2007–2018. As a firm's decision for SA might be endogenously driven and may not be randomly assigned, we apply the Heckman (1979) two-stage correction technique. We derive our choice model for SA based on our field evidence and literature. Next, building on the model of Anderson et al. (2003) we include SA as an additional driver of resource adjustments. Their model measures the relationship between changes in resources committed

(i.e., approximated by costs) and changes in activity levels (i.e., approximated by sales revenues) in the event of an activity decline. We use two different proxies to estimate the adjustment of resources: total costs and sales, and general, and administrative (SG&A) costs, and document a significant and economically meaningful reduction in cost stickiness attributable to SA for both. Firms having SA adjust their total (SG&A) costs by 17.00 (25.60) percentage points more relative to their peers in the event of a 1 percent decrease in sales.

Next, drawing on the firm-year measure of cost asymmetry by Kaspereit and Lopatta (2019), we derive a measure for an estimated portion of SA-related total (SG&A) cost asymmetry. Our results indicate that the SA-related portion of total cost asymmetry (SG&A) is positively associated with firm value, approximated by Tobin's q (Tobin, 1969). The effect size is economically meaningful. An increase in the standard deviation of SA-related total (SG&A) cost asymmetry translates into a 2.691 (1.276) percent increase in Tobin's q relative to its sample mean. This finding supports our notion that resource adjustments linked to SA are linked to an enhanced information set about committed resources. Thus, a fraction of sticky cost behavior that potentially harms firm value is resolved.

Our study contributes to the literature mainly in two ways. First, we contribute to the debate on the usefulness and the value of SA (DeFond & Zhang, 2014, 294). Prior studies on SA suggest a signaling effect translating into lower cost of equity capital and higher firm value (Casey & Grenier, 2015; Clarkson et al., 2019; Pflugrath et al., 2011). However, evidence on the internal effects (and whether they can also enhance firm value) of SA is scarce. Studies indicate that SA affects a company's ESG reporting and related activities (Ballou et al., 2018; Steinmeier & Stich, 2019). In contrast, we theorize and show empirically that SA improves internal resource adjustments, which translates into enhanced firm value. Hence, we are the first to analyze internal effects of SA on managerial decision-making.[57]

Second, we contribute to the literature on the drivers of cost asymmetry (along with many others, e.g., Anderson et al. (2003) and Chen et al. (2012)). In particular, by analyzing the impact of SA on resource adjustments and the implications of such resource adjustments on the value of the firm, we demonstrate that not adjusting resources adequately can harm firm value. In particular, we argue that a key underlying factor for such inefficiencies is incomplete information sets that are relevant for resource adjustments. Our study provides evidence that

[57] We are only aware of one empirical SA study with a within-firm perspective. Steinmeier and Stich (2019) address the effects of SA on environmental and social (ES) ratings (i.e., limiting their analysis fully to the ESG context). However, our study arguably differs as we focus on the overall managerial decisions beyond ES ratings and hence capture a spillover effect of SA. It is ex-ante unclear whether the link between SA and ES ratings translates into a positive effect of SA on resource adjustments.

SA helps to mitigate these informational inefficiencies, suggesting that while financial data facilitates a deeper understanding of a firm's operations (as suggested by Kim et al. (2019)), so does the assurance of ESG data.

Our study has implications for practitioners, particularly given the criticism of SA also in the academic space (Boiral & Heras-Saizarbitoria, 2020; Michelon et al., 2015). SA will likely become more common in the US given the Securities and Exchange Commission's (SEC) new proposal on disclosing climate-related information (SEC, 2022).[58] Outside the US, the ESG reporting landscape in the European Union (EU) is set to change substantially (EU Commission 2021), with SA becoming mandatory for many EU firms.[59] Our study shows that SA has firm-*internal* economic benefits, thus providing support for the regulatory movement towards mandatory SA. Our results indicate that the advisory elements of SA are particularly important for companies. Given the importance of internal effects, regulators may be cautious in urging independence and streamlining of the SA process as they attempt to establish consistent SA standards. Providers facing massive demand may find it important to consider this service perspective and the benefits it could bring internally, rather than just providing SA certification.

2. Hypotheses Development

2.1 Consequences of Sustainability Assurance

Companies utilize SA to enhance credibility of their ESG disclosure to gain legitimacy and protect their reputation (Simnett et al., 2009). Experiments indicate that SA signals credibility of ESG disclosures to users (Pflugrath et al., 2011), reducing asymmetric information distribution. Empirically, this translates to lower bid-ask spreads (Fuhrmann et al., 2017), lower cost of capital, and higher market valuation (Casey & Grenier, 2015; Clarkson et al., 2019).

However, studies investigating various aspects of SA, such as the dominant role of management, increasing demand for stakeholder inclusiveness, providers' (in)dependence, the creation of demand and legitimacy, and the ongoing evolution (Manetti & Toccafondi, 2012; Michelon et al., 2019; O'Dwyer et al., 2011; O'Dwyer, 2011), collectively support the view that

[58] The SEC rule includes mandatory external verification of CO_2 emissions disclosures.

[59] The EU Corporate Sustainability Reporting Directive includes compulsory assurance for the mandatory ESG disclosures. Our evidence suggests that companies are indeed preparing for these upcoming mandatory changes and the associated institutional pressure. ("We're trying to get ahead of the game, as we start to see the SEC drivers and the EU taxonomy coming along, there's no one more or less saying your entire report has to be audited or assessed" (C 18)). However, assurors and companies stated that regulatory pressure is not their only motivation to engage in SA: "I think in general, the big companies, they are very advanced in their reporting, but they don't just do the reporting to comply with the law" (A 6)).

SA is far more than an external verification means for ESG disclosures, and that the internal benefits of SA may be at least as important as its external benefits (Ball et al., 2000; Edgley et al., 2010; O'Dwyer et al., 2011; O'Dwyer, 2011; Owen et al., 2000). Understanding the potential firm-internal impact of SA is critical given the growing importance of SA globally for providers and receiving companies. For instance, companies associated with high ESG risks and tainted ESG reputation use more non-audit services, suggesting ESG risk management (Asante-Appiah & Lambert, 2022). Schoenfeld (2022), in this context, analyzes the increasing use of voluntary service organization control audits.

According to the professional services perspective introduced by Knechel et al. (2020), both the client and the auditor seek to provide credible information when considering financial audit engagements. The audit process consists of close interaction and collaboration between the audit team and the client's staff. Concerning SA, literature suggests that SA includes not only *assurance* elements (i.e., disclosure review), but also *advisory* elements (i.e., collaborative creation of an auditable environment).

Assurance- and *advisory*-related activities may have direct effects during the SA process. Providers indicate that SA assists companies by evaluating systems and processes for reporting (O'Dwyer et al., 2011). Before initial SA engagements, ESG data collection is in most cases rather rudimentary. Internal collection rarely follows documented processes, and data quality is often insufficient (O'Dwyer et al., 2011). SA providers *advise* their clients to improving internal controls and reporting structures to create an auditable environment (O'Dwyer et al., 2011; O'Dwyer, 2011). Moreover, SA providers detect misreported ESG data, resulting in restatements (Ballou et al., 2018). Further directly linked outcomes of SA are modifications to ESG disclosures and ESG-related activities (Boiral et al., 2019; Steinmeier & Stich, 2019).

According to Maso et al. (2020), SA providers utilize complementary information about deficiencies in processes and systems that they incorporate into their financial audit, thereby improving audit quality. This is an example of an indirect effect channel for SA providers. By analogy, we are interested in whether SA enables firms to modify its management decisions due to enhanced knowledge regarding resources committed. Figure III-1 summarizes the possible SA impact channels (direct vs. indirect) via SA along the SA engagement timeline (pre, during SA, and after SA).

In addition to the direct effects of the *assurance* and *advisory*-related SA activities, by identifying the strengths and weaknesses of internal control systems, SA could yield valuable firm insights (Ball et al., 2000). We argue that this could have rather *indirect* effects, possibly

enhancing stability and mitigating exposure to unexpected shocks (Owen et al., 2000). Moreover, non-financial data is becoming increasingly important for strategic orientation. Cohen and Simnett (2015) emphasize that ESG data is relevant for both external stakeholders and internal managers in their decision-making processes.

2.2 Interview Evidence

The SA process within a firm is not observable to outsiders (O'Dwyer, 2011). Thus, we followed Soltes (2014) and supplemented archival data with field data collected from interviews with assurors and insiders in SA-receiving firms. We structured the interviews with guidelines around five main themes: (i) the objectives of SA, (ii) the SA process itself, (iii) outcomes of the ESG reporting process, (iv) outcomes beyond the ESG reporting process, and (v) the evolution of the SA process (see, Appendix Part II).[60] The main and follow-up questions are open-ended to maintain the flow of conversation (Bryman, 2016; Rowley, 2012). We were especially interested in communications and patterns beyond verification activities (i.e., tasks of a consultative nature), although we were sensitive in framing our questions as in some jurisdictions, SA providers are more obliged to maintaining independence during engagements.

We interviewed 30 individuals across two groups, SA providers and corporate insiders responsible for the SA process. One concern about only interviewing SA providers was that they may provide overly positive statements about their SA service. We hence interviewed corporate individuals with an internal perspective and aimed to match (i.e., verify) claims by SA providers. The literature primarily splits SA providers into accounting firms and sustainability consulting firms (Simnett et al., 2009). We focus in our interviews on the Big Four because accounting companies audit the majority of global ESG reports (> 60%) (International Federation of Accountants, 2021), and the Big Four have a significant market share (Canning et al., 2019; O'Dwyer, 2011).[61] The first group consisted of 15 assurors. We identified our interview partners via a request e-mailed to each of the Big Four, explaining the context of the study.[62] We interviewed one associate, six senior associates, one (senior) manager, one director, and

[60] Notably, we used themes (ii) to (v) to generate insights to guide our qualitative analysis. Theme (i) was introduced in the interviews as warm-up and later helped motivate and validate our selection model in archival tests. Further, we derived from this section the internal usage of ESG-related data in firm-internal decision-making processes. In theme (iv), we derived insights into operational processes and resources committed.

[61] Similarly, our sample of archival data analysis reveals that 49.99 percent of all SA mandates are held by the Big Four.

[62] All Big Four firms participated in at least one interview. Since there are other audit firms besides the Big Four that have a smaller market share but are developing their SA services, we also approached second-tier audit firms to assess whether they pursue a comparable method. One agreed to be interviewed. We also contacted the main non-accounting providers on the market, none of which agreed to participate.

two partners. The experience of our first group of interviewees varied from one year (associate) to 15 years (partner and director). Our second group consisted of 20 firm insiders responsible for the SA process. We identified them by contacting alumni, leveraging existing relationships (O'Dwyer et al., 2011), and sending requests using LinkedIn and investor relation channels on company websites.[63] Their experience and responsibility ranged from two (sustainability reporting analyst) to 22 years (head of sustainability strategy).

We conducted interviews with firms and departments located in Austria, France, Germany, Italy, Japan, Spain, and the US. All interviews lasted between 40 and 60 minutes and took place online between June 2021 and October 2022. We recorded all interviews and fully transcribed them afterward.[64] Table III-1 summarizes the information on the interviews. Reference codes A (C) denote the provider (insider) of the individual interview quotes. We analyze the transcripts using a qualitative, interpretative approach with three sub-processes: data reduction, data display, and conclusion-drawing (O'Dwyer, 2004). First, we identify key points that indicate possible insights from the SA process about the processes in place and the resources committed during SA. Next, we draw a summary matrix for each transcript, compare them, discuss the findings, and summarize them. Based on our interviews, we categorize the SA process into four phases: preliminary assurance, main assurance, results communication, and results implementation. In addition, we distinguish between the assurance and advisory elements of SA.[65] Figure III-2 summarizes our analysis, which is presented in the narrative below.

2.3 Preliminary Assurance Phase

Seven assurors explicitly refer to materiality assessments and discussions they have with their clients to identify material ESG issues within their business model, contributing to a deeper understanding of its interdependencies. Six insiders note that they talk to their SA provider or engage directly with them as part of the SA process to identify business-relevant ESG topics.

[63] We approached all companies in the DAX40, SP500, Nikkei 225, CAC40, FTSE MIB, ATX where we found an English reference to SA and where we could identify a contact on LinkedIn or where we found contact details on the company website. The positive response rate of all companies contacted was just below 5%.

[64] For two participants who decided against recording, two authors from the author team conducted the interview. One author took detailed notes, used them to transcribe the interview directly afterwards, and clarified any questions with the participants via e-mail.

[65] Knechel et al. (2020) suggests that auditing can be approached from two perspectives. The manufacturing perspective provides a clear outcome such as an audit opinion, while individual companies provide information on demand. From the service perspective, the desired outcome is to reduce information risk and advise management on how to achieve reporting and management objectives, while clients and auditors work together to achieve credible disclosure. We consider these two perspectives when analyzing the field data. For instance, the assurance elements we identify are linked to standardized assurance activities, such as information verification. Advisory-related activities are close interactions with the client team, leading to adaptations and modifications during the SA process.

Additionally, twelve insiders refer to pre-SA activities assessing capabilities, systems, and controls relevant to SA. Seven assurors explain that they often supply feedback. In several cases, pre-SA helps clients establish necessary processes.

All assurors state that they follow a risk-based approach and assess their clients' risk internally ex-ante the SA engagement. In particular, seven assurors state they engage in open discussions with their clients about their risk exposures, helping to raise awareness of material data and processes. Five insiders mention assurance risks directly in the context of SA planning.[66] During all SA activities assurors and insiders suggest that SA is more than a mere verification tool. For all SA activities we identify references to advisory elements associated with the SA process. In particular, we suggest that during this phase, companies learn more about their business model with regards to material ESG issues and about any weaknesses and risks in their ESG reporting and related data management.

2.4 Main Assurance Phase

Eleven assurors refer to the process and data reviews in the main assurance phase as providing a greater understanding of operations. During this phase, the consistency, scope, and understanding of the data and the underlying processes are challenged. Frequently, they note that this additional ESG-related information provides different perspectives to the SA receivers. Ten insiders acknowledge that SA helps highlight inconsistencies and that SA providers are helpful in challenging the data, particularly given that companies are often understaffed when it comes to ESG disclosure.[67]

Eight assurors claim they often discover inconsistencies in the data and engage in discussions to resolve these and help re-capture the data. Likewise, nine insiders refer to having multiple rounds of discussions during the SA process with providers about their data, related processes, and governance structures. Both sides point to an exchange of knowledge during the SA that spanned different departments and levels of hierarchy. Again, we identify advisory elements in all of these activities. Providers not only review information, they also challenge and discuss it with those responsible. Altogether, we find indications that during pre-assurance

[66] Since these issues are more important to assurors in the pre-assurance phase, insiders are more likely to raise them during the results communication phase.

[67] Both interview groups emphasize that resources for ESG disclosure and SA are much more limited than those for financial reporting and audit. ("Our finance team, who provides information for the audit report and coordinates the entire audit, consists of hundreds of people. For sustainability [reporting], we have me." (C 8)). ("As a small, sustainable staff department, we do not have a high level of data. The data is generated, processed, and prepared in other departments." (C 9)).

and main assurance, companies learn about their operations and resources in place, share this information, and discuss it with their providers.

2.5 Results Communication Phase

Ten company insiders highlight the perceived pressure of not receiving SA, raising overall awareness around ESG-related data and issues. By contrast, five assurors refer to the common goal of achieving SA for the client and mention they engage in open discussions to overcome challenges during the SA process. Turning SA into a consulting project to prepare the client was mentioned as an option if a given client was considered insufficiently mature.

Ten assurors mention that in addition to the SA statement, they provide a management report/letter which includes findings and key issues identified throughout the SA process, as well as suggestions for a more robust reporting environment. Eight insiders refer to similar documents or services provided by their respective SA providers. They highlight the importance of this summary in raising overall internal awareness on data-related processes and ESG-related data. One assuror also mentions that individuals within the company utilize SA reports to promote awareness among top management.

Another channel, mentioned by nine assurors, is the discussion of the results of the SA process with the client's management. Twelve insiders explain that they have discussions with the assurors, but also internally, after the SA, to derive actions. In particular, they mention that SA identifies what needs to change.

2.6 Results Implementation Phase

After communicating the results, the providers' official involvement ends. We therefore identify rather advisory elements here. However, SA engagements flow seamlessly into one another, especially in large companies. Six assurance providers mention that in the subsequent SA, they often verify whether the recommendations have been implemented. There is also an observable increase in internal awareness of SA.

Five insiders mention projects they have initiated, or plan to, based on the data generated and reviewed in the SA process. Similarly, seven assurors mention changes or integration of ESG reporting into financial reporting (e.g., existing SAP programs) with impacts on master data management and data quality and availability. In some cases, major recommendations are implemented in consulting projects in collaboration with the SA provider. Eight insiders state

that SA is relevant to the management of key ESG metrics and that SA is necessary to obtain reliable data for strategic decisions. Eleven assurors indicate that ESG-related data and issues are gaining importance in financial and strategic decisions.

Overall, we interpret the evidence regarding the communication of the results and the interpretations to mean that verified and trustworthy data, as well as the push from the provider, enable companies to integrate ESG measures into their IT and management systems to aid strategic decision-making.

2.7 The relationship Between SA and Resource Adjustment

To examine the indirect effect by which the SA process influences operational knowledge, we focus on firms' internal resource adjustments in response to a decline in output because it allows us to observe whether SA drives ad-hoc resource adjustment decisions in response to changing environments (i.e., decline in demand) based on committed resources. Theoretically, committed resources comprise fixed and variable components that vary symmetrically with changes in activity levels (Cooper & Kaplan, 1992). However, according to Anderson et al. (2003) certain resources committed are neither fix nor variable, but *sticky*. *Sticky resources* require management to deliberately adjust decisions in the short run at a certain cost.[68] Here, managers postpone resource adjustments in the event of a decline in output, resulting in an under-adjustment of resources, because they face uncertainty about future demand and resource requirements (Anderson et al., 2003; Lee et al., 2020). Hence, this postponement is equivalent to a real option that involves opportunity costs for the waiting choice (i.e., the cost of holding unused committed resources) (Kim et al., 2019).

Managers rely on external and internal sources of information when assessing the future (Heitzman & Huang, 2019). Poor internal forecasting (e.g., due to internal control weaknesses) means management is uncertain about the firm's future activities so management tends to retain redundant resources (Kim et al., 2019). But managers are not only confronted with potentially incorrect information in forecasting, they also face uncertainties about any resources and related costs already committed (Harris et al., 1982; Pindyck, 1982). In consequence, the quality of internal decision-making is also determined by knowledge of cost drivers and structures of resources committed (Gupta & King, 1997). Specifically, information on resources consumed and required is assumed to be dispersed across corporate divisions, which influences internal resource allocation (Antle & Bogetoft, 2018). In this context, divisional managers pursue self-

[68] For instance, weighing the cost of laying off and then recruiting staff in the next period.

interested empire-building motives by exploiting their information advantage (Stein, 2003), resulting in inefficient internal resource allocation (Glaser et al., 2013).

Our field evidence suggests that SA provides top managers additional internal information about business operations from a non-financial/indirect angle, as it gives them more precise information concerning future developments as well as committed and required resources. Consequently, improved information on resources is supposed to induce firms to reduce the opportunity costs of waiting (i.e., leading to greater resource adjustments). Likewise, managers adjust resources to a greater extent in the event of a decline in output as SA reduces uncertainty about future developments and internal resource requirements (Anderson et al., 2003; Lee et al., 2020). Moreover, previous surveys and our qualitative findings suggest that managers increasingly incorporate ESG measures into their controlling processes and strategic decisions as they have steering relevance (Banerjee, 2002; Gates & Germain, 2010; Henri & Journeault, 2010; Perego & Hartmann, 2009). Incorporating this increasingly strategically important data enables companies to better forecast future demand.[69] We argue that incorporating ESG measures helps improve knowledge of the future usability of committed resources.

Empirical evidence shows that while managers expand resources quickly when output levels increase, they stick to unused committed resources (captured by costs) in the event of a decline in activity levels (captured by sales revenue)—a phenomenon referred to as *cost stickiness* (Anderson et al., 2003).[70] Derived from the rationale above, we argue that SA reduces cost stickiness. Figure III-3 demonstrates the suggested impacts of the SA process on managerial decisions regarding the adjustment of committed resources.

However, it is *ex-ante* unclear whether this relationship manifests empirically, as companies undergoing SA usually also commit more sticky resources to ESG activities (Habib & Hasan, 2019). Moreover, management has significant power to shape SA by determining its scope and level (Owen et al., 2000). Managers also have discretion in deciding how to implement providers' recommendations and may be reluctant to follow these (O'Dwyer et al., 2011). Similarly, our interview data suggests that SA outcomes are a matter of resources and managerial engagement. So, while we provide several arguments and interview-based evidence that SA ought to improve companies' resource adjustments, its impact remains an empirical question. We test the following hypothesis:

[69] "One client has started to implement recycled content and recyclability data in their SAP systems to align or to be able to get high quality data and packaging or sustainable packaging in that case." (A 7).

[70] Conversely, an excessive reduction in resources in the case of a sales decline—particularly under the assumption of overcapacity—is referred to as the *anti-stickiness* of costs (Weiss, 2010).

Hypothesis 1 (H1). Companies that have SA adjust their committed resources to a larger extent (i.e., show less cost stickiness).

2.8 Resource Adjustments Attributable to SA and Firm Value

Most studies argue that some degree of under-adjustment of resources in the event of a decline in output levels may benefit a firm (Anderson et al., 2003; Banker & Byzalov, 2014; Banker et al., 2018; Chen et al., 2012). Sticking to committed resources prevents potential reinstatement and reemployment costs.[71] However, there are two intra-firm drivers of resource adjustment postponement: a) opportunistic managerial incentives, such as empire building (Chen et al., 2012), and b) the lack of timely and accurate internal information (Kim et al., 2019), none of which are grounded in the economic rationale of maximizing firm value. According to Chen et al. (2012), resources that are not cut in the event of a decline in activity attributable to managerial incentives create reduced value in the future, suggesting there is a beneficial and a harmful portion of under adjustment (Banker & Byzalov, 2014). Considering that under-adjusting resources may stem from rational intentions but may also reflect inefficiencies due to firm-internal agency conflicts and imperfect information, the question arises whether changes in resource adjustments triggered by SA are beneficial or not for a company.

Based on our rationale derived from the field evidence in the development of H1, SA supplements internal managers with information they in turn may leverage within their resource adjustment processes. In particular, company insiders disclose that the SA process helps harmonize data and identify inconsistencies that inform economic decisions such as business travel,[72] waste management,[73] or energy sources.[74] These environmental factors are closely related to resource consumption and reducing them potentially increases a company's value

[71] Prior literature has identified four major categories of firm-specific conditions and circumstances that influence managers' decisions regarding cost adjustments besides the information available: (1) adjustment costs of reducing and subsequently replacing them when activity levels rebound; (2) required existing and future slack resources; (3) managerial expectations and uncertainty regarding future economic and demand conditions; and (4) agency and behavioral factors (Banker et al., 2018; Banker and Byzalov, 2014). We refer to Figure 3, which shows how these drivers influence cost stickiness (i.e., resulting in either an increase or decrease). According to these four categories, existing literature has identified a variety of factors within these categories, such as asset or employee intensity, economic activity and development of previous activity levels (Anderson et al., 2003), managerial empire-building (Chen et al., 2012), and earnings management (Dierynck et al., 2012; Kama & Weiss, 2013). Further factors include employment protection legislation (Banker et al., 2013), life cycle stages (Anderson & Lee, 2015), and political uncertainty (Lee et al., 2020).

[72] "If they detect something about business trips, for instance" (C 15).

[73] "Especially in the waste area we often have some differences" (C10).

[74] "We steer certain decisions regarding travel or where we source our energy from" (C 2).

(Schaltegger & Figge, 2000). Other insiders point to the integration of ESG into overall strategic decisions enabled by more correct data through SA,[75] and a more sophisticated risk management.[76] ESG factors increasingly help companies to anticipate operational and reputational risks affecting firm value (Asante-Appiah & Lambert, 2022). On this, insiders confirm that ESG data responsibility often lies with different departments, sites, and subsidiaries, often giving them an information advantage regarding their processes over the headquarter.[77] Internal frictions between headquarter and sites lead to inefficient internal resource allocations, harming firm value (D'Mello et al., 2017). Moreover, the SA process pushes companies towards more frequent reporting cycles of their ESG data,[78] potentially resulting in better monitoring, and ultimately translating into higher firm value (Kajüter et al., 2022).

Consequently, we argue that resource adjustments related to SA improve firm value as they arguably mitigate the two firm-internal drivers of resource adjustment postponement which is said to harm firm value. First, asymmetric information due to agency conflicts between headquarter and subsidiaries and secondly, unrecognized inefficiencies and inconsistencies in processes and data. Thus, we formulate our second hypothesis:

Hypothesis 2 (H2). The part of resource adjustments attributable to SA is positively associated with firm value.

3. Archival Research Design

3.1 Model Estimating Sustainability Assurance and Cost Asymmetry

To test H1, we consider the relationship between resource adjustments according to the level of activity attributable to SA in the event of a decline in activity levels. Since SA is still voluntary in most countries, the selection of companies that implement SA may be endogenously driven. We apply the Heckman (1979) two-stage correction technique for such a potential non-random selection.

For the first-stage choice model, we derive independent variables in the selection model based on the interview data and prior literature. We focus on the external pressures on firms to engage in SA as a variable that is arguably relevant for SA selection (i.e., relevance condition)

[75] "This key information is getting more important for our strategic management" (C 1).
[76] "We also integrate ESG and risk management in the mainstream risk management processes" (C 4).
[77] "It definitely helps also to have the insights from the external auditor to get a better understanding from the perspective of the processes in the OEs [operating entity]" (C 14).
[78] "Suddenly we are in a controlling process, not in a corporate communications process" (C 15).

but not linked to a firm's decisions regarding resource adjustments (i.e., exclusion restriction).[79] Media attention towards firms strongly leads them to engage in and disclose on ESG (Nikolaeva & Bicho, 2011).[80] Thus, we argue that the decision to engage in SA is influenced by media attention to SA (*SA_MEDIA)* exerting external pressure.[81] Our first-stage probit model is:

$$\begin{aligned} Prob(S\_A = 1)_{i,t} = \beta_0 + \beta_1 SA\_MEDIA_{i,t-2} + \beta_2 LEGAL_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} \\ + \beta_5 ROA_{i,t} + \beta_6 ESG_{i,t} + \beta_7 ESGD_{i,t} + \beta_8 BIG4_{i,t} + \beta_9 DAC_{i,t} \\ + \beta_{10} ASY_{i,t} + INDUSTRY\ FE + \epsilon_{i,t}, \end{aligned} \quad (1)$$

where *S_A* is an indicator variable equaling one if a firm undergoes SA in the current period, zero otherwise.[82] We use the variable *CSR reporting external audit* from the Refinitiv ESG database to identify whether a firm undergoes SA.[83] Besides *SA_MEDIA*, our first-stage probit model includes variables that prior studies have identified as determinants of SA (Casey & Grenier, 2015; Kolk & Perego, 2010; Simnett et al., 2009; Steinmeier & Stich, 2019). We

[79] "The driver was to give comfort to, at that time, not the board of directors but the public in general" (A 1).

[80] Focusing directly on media coverage of SA itself, rather than on media coverage of individual firms, helps us mitigate identification concerns, as general media coverage of individual firms could be due to a range of other factors such as managerial style or company performance (Liu et al., 2017) that do not capture SA, raising doubts about the validity of the variable.

[81] We define *SA_MEDIA* as the natural logarithm of the number of all articles in the Factiva news database that contain SA-related keywords two years before firms' SA engagements issued in neighboring countries a company is headquartered. A detailed list of all keywords is provided in panel B of Table III-2. To ensure that *SA_MEDIA* represents the average media attention to SA and is not driven by the company in the current observation when computing *SA_MEDIA*, we do not rely on the number of articles published in the country in which a firm is located. We define neighboring countries as countries whose capitals are less than 1,000 km (621 miles) from the border with the company's country of domicile. Further, we apply two years of lags, as companies need to decide to adopt SA before the actual assurance engagement occurs (first lag). Further, external pressure likely takes hold with some delay (second lag).

[82] For first-time adopters of SA, we assign a value of one to *S_A* in the year before the first official assurance process, as first-time adopters are particularly likely to undergo a so-called "pre-assurance" or "readiness assessment" and we want to capture its internal effect (Channuntapipat et al., 2019; Farooq and Villiers, 2019). Our interview evidence also suggests similar approaches. Further, after adopting SA, only 0.9 percent of observations in the sample reverse their SA strategy, indicating that the decision to engage in SA is a persistent attribute. Thus, the preparation activities for the first SA engagement begin with some lead time, which allows providers to create an "auditable environment" (Channuntapipat et al., 2019). Our results show similar significance and coefficients without this adjustment.

[83] Beyond the prevalence of SA, previous literature on the effects of SA on external stakeholders has also investigated the level of assurance (Cuadrado-Ballesteros et al., 2017). The most prominent assurance standards on SA (IASE3000 and AA1000AS) distinguish between a limited/moderate and reasonable/high level of assurance, reflecting the effort undertaken by the auditor in the assurance process, with "limited" indicating an acceptable but substantially higher assurance risk than that denoted by a "reasonable" level of assurance (Manetti and Toccafondi, 2012). We addressed in our interviews whether there is a difference between the SA processes when obtaining a limited vs. a reasonable assurance level. The responses indicate that reasonable assurance is still very rarely observed, especially for the entire ESG disclosure. In addition, companies and auditors reported that after SA is initially implemented, internal and provider teams collaborate over several years to develop a reasonable assurance level. Therefore, there should be no incremental difference in the effect of these different levels. "When a company switches from limited to reasonable assurance, normally they involve people already know the audit process" (A 3). We hand collected the information on the SA level from the ESG disclosures. Our empirical test regarding limited vs. reasonable assurance confirms the interview evidence, as there is no difference in the effect.

include a measure for the legal structures of the country where a firm is domiciled (*LEGAL*) and further firm-level measures such as size (*SIZE*),[84] profitability (*ROA*), and financial structure (*LEV*). As cost stickiness is positively associated with the volume of ESG disclosures (Golden et al., 2020), we include the firm and year-level measure of asymmetric cost behavior (*ASY*) developed by Kaspereit and Lopatta (2019).[85] Prior studies as well as our interview evidence show that ESG performance (Clarkson et al., 2019)[86] and ESG disclosure (Sethi et al., 2017) influence the decision to undergo SA. Accordingly, we include *ESG* (i.e., the overall *ESG performance score* from ESG Refinitiv) and *ESGD* (i.e., the *ESG disclosure score* from Bloomberg).[87] Next, we include a dummy equaling one if the company's financial statements are audited by one of the Big Four (*BIG4*) as this could influence a company's likelihood of adopting SA (Fernandez-Feijoo et al., 2018). Additionally, we capture financial reporting quality using unsigned discretionary accruals *(DAC)* (Cameran et al., 2016; Chi et al., 2017).[88] Lastly, we control for industry affiliation by including industry fixed effects.[89] Table III-2 provides detailed definitions of all variables.

In the second stage, we follow the model of cost behavior developed by Anderson et al. (2003) and analyze the relationship between changes in costs and changes in sales levels:

$$\begin{aligned}\log(\Delta COST)_{\mathrm{I,t}} = {} & \beta_0 + \beta_1 D_{i,t} + \left(\mu_0 + \mu_1 S\_A_{i,t} + \sum \mu_{\mathrm{n}} DET_{i,t}\right) \times \mathrm{D_{I,t}} \times \log(\Delta Sale)_{\mathrm{I,t}} \\ & + \left(\lambda_0 + \lambda_1 \mathrm{S\_A_{I,t}} + \sum \lambda_{\mathrm{n}} DET_{i,t}\right) \times \log(\Delta Sale)_{\mathrm{I,t}} + \delta_1 S\_A_{i,t} \\ & + \sum \delta_{\mathrm{n}} DET_{i,t} + \nu_1 D_{i,t} \times S\_A_{i,t} + \sum \nu_{\mathrm{n}} D_{i,t} \times DET_{i,t} \\ & + MILLS + YEAR\ FE + FIRM\ FE + \epsilon_{i,t},\end{aligned} \tag{2}$$

where *log(*Δ*Sales)* is the logarithm of changes in revenues, capturing changes in activity levels.[90] *Log(*Δ*COST)* is the logarithm of changes in either total or SG&A costs. We consider two different cost measures (*log(*Δ*Total)* and *log(*Δ*SG&A))*. Following Kaspereit and Lopatta

[84] "That's a very general statement. But the smaller companies are often not as engaged" (A 4).

[85] We strictly follow Kaspereit and Lopatta (2019)'s method for their firm-level measure of cost asymmetry and estimate the values based on the full Compustat Universe for total (SG&A) costs. We refer to their methodology section for further details.

[86] "It's very important for them to publish [an assured ESG report], and to show to the society that they're really engaged in sustainability topics so that they do something for their customers, for their employees, and for society itself" (A 5).

[87] "But once you have very proper, very mature reporting systems in place, it's quite easy or relatively easy to provide assurance on that as well. So, it would be surprising to have the very decent reporting systems controls, data quality, data availability, and not assurance of that" (A 2).

[88] "If they have good financial statements, they have [ESG] reporting processes in place" (A 5).

[89] "I would say, especially in, this might be a surprise, but the automotive industry, they're quite far advanced" (A 6).

[90] We follow prior literature and use a model on logarithm in changes to mitigate heteroscedasticity and facilitate economic interpretation (Anderson et al., 2003; Chen et al., 2012; Chen et al., 2019).

(2019) we use total costs as broader cost measures are commonly chosen in cross-country approaches to facilitate comparability across countries (Banker et al., 2013; Calleja et al., 2006). Moreover, total costs capture all costs that fall within the range of deliberate management decisions. In addition, SG&A costs are more directly linked to sales revenues (a proxy for sales volume). Thus, we also use SG&A costs (Anderson et al., 2003).

D is an indicator variable taking the value of one if sales decrease in the current period, zero otherwise. *DET* denotes a list of determinants driving cost asymmetry. The coefficients on interaction terms including $D \times log(\Delta Sale)$ (i.e., $\mu_0 + \mu_1 S\_A_{i,t} + \sum \mu_n DET_{i,t}$) capture the incremental change in total (SG&A) cost adjustments in response to decreases in sales depending on the corresponding determinants. Negative (positive) values of the coefficients indicate a lower (higher) adjustment in case of a decline in sales, i.e., higher (lower) cost stickiness. In line with H1, we expect μ_1, capturing the SA-related part of cost asymmetry, to be positive.

As determinants of cost behavior, we first include ESG performance (*ESG)* to separate SA from the effect ESG activities have on asymmetric cost behavior (Golden et al., 2020; Habib & Hasan, 2019). The amount of external ESG disclosure could also influence the internal information environment and managerial cost decisions. Hence, we include the quality of ESG reporting using Bloomberg's ESG disclosure score *(ESGD)*. Asset intensity (*logAINT*) and employee intensity (*logEINT*) capture adjustment costs (Anderson et al., 2003). We control for prior sales decrease (*PRSDEC*) because firms view successive decreases in sales as more permanent and thus are more inclined to adjust their resources (Anderson et al., 2003). We also control for firms in initial, growth, or decline life-cycle stages (*LC_IGD*), which tend to have higher levels of unused resources (Anderson & Lee, 2015).[91] Macroeconomic conditions influence managers' expectations. Hence, we include real growth in the gross domestic product (Δ*GDP)* and a dummy for a decline in property, plant, and equipment in the prior period (*PPEDEC)* (Anderson et al., 2016). To account for agency conflicts, we control for prior losses (*LOSS_PRIOR),* as this increases the pressure on managers to report profits in the following period (Dierynck et al., 2012), and *SMALL_PROFIT* to capture managers' incentives to meet or beat earnings expectations (Kama & Weiss, 2013). Further, we add free cash flow (*FCF*) to capture managerial empire-building (Chen et al., 2012). Lastly, we include firm (which also absorbs differences across countries and industries) and year-fixed effects. Table III-2, Panel A provides detailed definitions of all variables.

[91] We calculate *LC_IGD* as in Kaspereit and Lopatta (2019) and set missing values for debt in current liabilities, common dividends, preferred dividends, preferred stock, and capital surplus to 0.

3.2 Model Testing the Association Between the SA-Related Part of Cost Asymmetry and Firm Value

To test H2, we investigate the relationship between the proportion of resource adjustments attributable to SA and firm value. To capture the proportion of SA in each firm's total (SG&A) cost asymmetry, we utilize the yearly firm-level cost stickiness measure of Kaspereit and Lopatta (2019). Accordingly, we run rolling five-year pooled cross-sectional regressions by global industry classification standard (GICS) sectors on Model (2).[92]

Using the estimated coefficients for each year and industry, we determine the differential in resource adjustments given a decrease in activity levels. In particular, we calculate the part of cost asymmetry related to SA ($SA\_ASY_{i,t,} = \widehat{\mu_1} S\_A_{i,t}$) and the residual component ($DET\_ASY_{i,t,} = \widehat{\mu_0} + \widehat{\sum \mu_n} DET_{n,it}$). We estimate the association between the SA-related part of cost asymmetry and firm value by following model:

$$Tobin's\ q_{i,t+1} = \delta_0 + \delta_1 SA\_ASY_{i,t} + \delta_2 DET\_ASY_{i,t} + \delta_3 EPSILON_{i,t} + \delta_4 S\_A_{i,t} + \sum \delta_z\ Controls_{i,t} + YEAR\ FE + FIRM\ FE + \epsilon_{i,t+1}, \quad (3)$$

where *Tobin's q* is our proxy for firm value.[93] We define *Tobin's q* following Kaplan and Zingales (1997)[94] and take the next period's value (Abernethy et al., 2019).[95] *EPSILON* captures the unexpected part in SG&A cost changes approximated with the residuals of the estimations of Eq. (2). We control for *S_A* itself, to single out the signaling effect of SA on the capital market (Martínez-Ferrero & García-Sánchez, 2017). To ensure that the part of cost asymmetry due to SA does not capture the part of previously established sound reporting and ESG activities, we segregate the part of cost asymmetry attributable to ESG activities (*ESG_ASY*) and ESG disclosure quality (*ESGD_ASY*) from the residual component and control both separately.

Further, we consider firm size (*SIZE*) (Allayannis & Weston, 2001). To account for financial market access and capital structure, we include dividend payments (*DIV)* and financial structure (*LEV)* (Allayannis & Weston, 2001; Chen & Steiner, 2000; Hoyt & Liebenberg, 2011). We consider profitability and include return on assets (*ROA)* (Allayannis & Weston,

[92] Due to the cross-sectional design by GICS sectors, we adjust Eq. (2) and remove firm and year fixed effects in line with Kaspereit and Lopatta (2019). As our sample consists of multiple countries, we supplement the cross-sectional regression with country fixed effects.

[93] We choose this measure as the market value reflects all future profits and therefore includes capitalized future benefits of the effect of SA on managerial decisions regarding cost adjustments (Himmelberg et al., 1999; Lang and Stulz, 1994).

[94] Their measure has been widely used by prior studies (e.g., Konijn et al., 2011; La Porta et al., 2002; Servaes & Tamayo, 2013).

[95] This mitigates potential market-valuation turbulence potentially associated with a decline in sales (Abernethy et al., 2019).

2001). By adding sales growth (*log(ΔSales)*), research and development expenses (*R&D*), and advertising expenses (*ADV*), we control for future growth opportunities (Himmelberg et al., 1999; La Porta et al., 2002).[96] Further, we include market share (*MKT*) for firms' negotiating power (Vomberg et al., 2015). As capital-intensive firms are less likely to adjust to economic challenges (Vomberg et al., 2015), we control for capital intensity (*CAPINT*). We include *FCF* as cash flows are positively correlated with investment opportunities (Bates et al., 2009). We control for overall governance (*GOV)*, as corporate governance affects firm value (Cunat et al., 2012). We include the bid-ask spread (*BID_ASK*) and the beta factor (*BETA)* to control for stock-market liquidity, transparency, and sensitivity (Konijn et al., 2011; Lang et al., 2012). Additionally, we include *ESGD* as the dissemination of information on corporate ESG performance alters shareholders' perceptions (Dhaliwal et al., 2011). Lastly, we include firm and year fixed effects. Table III-2, Panel C includes the variables employed.

3.3 Sample Selection

We baseline our sample against the intersection of all available companies available in Refinitiv ESG and Compustat North America/Global between 2007[97] and 2018 that report in local currency, excluding financial and state-owned companies. The initial sample consists of 33,062 observations.[98] We deflate accounting measures by the respective country-specific consumer price index to correct for inflation.[99] We exclude 21,586 observations that provide no data on SA. Following Anderson et al. (2003), we exclude 260 observations with negative total (SG&A) costs, negative sales, or total (SG&A) expenses larger than sales. We require non-missing data for all relevant accounting and economic measures, which reduces our sample by 5,579 observations.[100] Next, we merge the Bloomberg database to identify 3,679 observations with non-missing data for the ESG disclosure score (reduction of 1,958 observations). Following prior research (e.g., DeHaan et al., 2017), we exclude 359 singletons to avoid biased standard errors (Correia 2015), resulting in a sample of 6,320 observations from 1,631 firms to test our H1.

[96] For R&D and advertising expenses, we set missing values to 0 in line with Himmelberg et al. (1999) and Allayannis and Weston (2001), as companies are not required to report these.

[97] The first year (i.e., 2007) the Bloomberg ESG disclosure score is available narrows our sample period.

[98] In line with prior studies, we exclude financial and state-owned companies as their financial statements and cost decisions are structured differently (Chen et al., 2012; Kama & Weiss, 2013). For similar reasons, we exclude firms that report in a non-local currency or that changed their reporting currency in any period within the previous two years (Banker et al., 2013; Lee et al., 2020).

[99] Data obtained from the World Bank: https://databank.worldbank.org/reports.aspx?source=2&series=FP.CPI.TO TL&country=.

[100] Two lags of observations are required for the construction of some variables. Hence, we use data from 2006 and 2005.

To derive firm-level measures of asymmetric cost behavior, we run pooled rolling five-year regressions by GICS sectors. We include the 359 singletons while excluding all observations from cross-sectional regressions including fewer than 100 observations (48 observations). Thus, the firm-level estimates are based on a sample of 6,631 observations. Considering the rolling five-year window, obtained observations begin from 2011 to test H2 (5,152 observations). We exclude 1,039 observations due to missing values for the Tobin's q measure and required controls. Again, we exclude 258 singletons to avoid biased standard errors (Correia 2015). The sample for our H2 consists of 3,855 observations from 780 firms. Our sample selection procedure for H1 and H2 is presented in Table III-3, Panels A and B.

Table III-3, Panel C presents the distribution across the 40 (31) countries included in our sample for testing H1 (H2). Within the sample, 19.0 (17.0) percent of observations represent US and 24.5 (23.6) percent Japanese firms, similar to other recent cross-country studies on asymmetric cost behavior (Hartlieb et al., 2020; Lee et al., 2020).

3.4 Univariate Statistics

Table III-4, Panel A presents descriptive statistics for the sample of H1. On average, 73.2 percent of all observations have SA, indicating a majority of the companies voluntarily opt for SA. The mean (median) values of the controls are similar to those in prior studies.[101] Table III-4, Panel B presents the descriptive statistics of the variables that are employed in the selection model of the Heckman analysis. Table III-4, Panel C provides descriptive statistics for the test of H2. The average Tobin's q is 1.793, similar to other studies. Likewise, other control variables are in line with studies incorporating ESG data.[102] Table III-5, presents pairwise Pearson correlations of variables in the main regressions.[103]

[101] For instance, the frequency of prior sales decreases is 39.4 percent and of property, plant, and equipment is 29.6 percent, similar to Kaspereit and Lopatta (2019).

[102] We acknowledge that our sample overrepresents larger firms due to the limited ESG data provided by Refinitiv ESG. Accordingly, our measure of size with a mean of 9.281 (9.279) is somewhat above the values reported by Abernethy et al. (2019) of 8.031, but similar to those in studies that also incorporate ESG data (e.g., Steinmeier and Stich. (2019), with a mean of 10.124 for size).

[103] In Table 5, Panel A, the correlations of the variables for the test of H1 are significant and exhibit small values between the independent variables. None of these correlations raises multicollinearity concerns. Table 5, Panel B presents pairwise correlations of the variables incorporated in the test of H2. The lower (upper) triangle includes the independent cost asymmetry variables estimated on total (SG&A) costs. The correlation of five percent significance between the part of cost asymmetry related to SA based on total (SG&A) costs is 0.141 (-0.088) indicating a positive (negative) relationship.

4. Results

4.1 Sustainability Assurance and Resource Adjustments

Table III-6 presents the results of the test of H1. First, Panel A presents the results of the selection model for SA (Eq. (1)). Columns (2), (4), (6), and (8) report the coefficient estimates. From the estimated coefficients, we calculate the inverse of the Mills ratio (*MILLS*), which we include as an additional control variable in the regression model of Eq. (2).[104]

Panel B reports the main test of the association of SA with resource adjustments. For both cost measures, our variable of interest, $D \times log(\Delta Sale) \times S\_A$, captures the effect of SA on cost asymmetry. Column (1) (column (5)) contains coefficients of a reduced form of Eq. (2) including *S_A* as single determinant for total (SG&A) cost asymmetry. The coefficient of our main variable of interest, $D \times log(\Delta Sale) \times S\_A$, shows positive and statistical significance at the 5 (1) percent level (total costs: 0.211, t-val: 2.125 and SG&A costs: 0.419, t-val: 3.249). The model presented in column (2) (column (6)) includes *MILLS* calculated on the regression coefficients depicted in the respective column in Panel A. The coefficients on our variable of interest exhibit similar values (total costs: 0.221, t-val: 2.221 and SG&A costs: 0.422, t-val: 3.795). The next column (3) (column (7)) contains regression coefficients of the full model on Eq. (2). Again, the coefficients on our variable of interest continue to show positive and significant at the 1 percent level (total costs: 0.231, t-val: 2.969 and SG&A costs: 0.540, t-val: 3.576). The model in column (4) (column (8)) additionally includes *MILLS,* and provides additional support for our H1 with positive significant coefficients at the 1 percent level ((total costs: 0.230, t-val: 2.867 and SG&A costs: 0.541, t-val: 4.535) being robust to a Heckman (1979) correction.

The overall positive and significant coefficients on our variable of interest (i.e., $D \times log(\Delta Sale) \times S\_A$)) indicate cost adjustment to a greater extent for firms with SA in the event of a sales decline, which supports our H1. In terms of economic effect size, when a firm has SA, the adjustment of total (SG&A) costs in the case of a 1 percent decline in sales is 17.00 (25.60)[105] percentage points higher than in firms without SA (all else equal). Regarding the effect of SA in case of an increase in activity levels, $log(\Delta Sale) \times S\_A$ the negative coefficient

[104] Since we calculate *ASY*, one of the determinants in the selection model, based on total costs (SG&A costs), which we then use according to the cost variable in the second stage, the regression coefficients of the first stage differ depending on the second stage cost variable.

[105] We calculate the economic effect size based on the coefficients in columns (4) and (8). When calculating the economic effect of SA on total (SG&A) cost adjustments, one needs to add the effect of SA on total (SG&A) cost adjustments given a sales increase ($total\ costs: \lambda_1 = -0.060,\ SG\&A\ costs: \lambda_1 = -0.285$) and the effect of SA on SG&A cost adjustments given a sales decrease ($total\ costs: \mu_1 = 0.230,\ SG\&A\ costs: \mu_1 = 0.541$); e.g.: total costs: –0.060 + 0.230 = 0.170 and SG&A costs: −0.285 + 0.541 = 0.256.

for total (SG&A) costs (-0.006, t-val: 1.349 (-0.-0.285, t-val: 3.883) indicates that companies' costs increase along a lower slope if they have SA. But this effect is only consistently significant for SG&A costs.[106] The effect of the other determinants on total (SG&A) cost asymmetry is depicted by the coefficients on the interaction terms $D \times log(\Delta Sale) \times DET$. The estimated coefficients are statistically significant and have the expected sign for variables determining adjustments costs *(logAINT),* slack resources (*LC_IGD*), and managerial expectations (*PPEDEC*, and *ΔGDP*).

Table III-7 presents the results of the five-year rolling cross-sectional regressions by GICS sectors on the model in Eq. (2). Column (1) (column (2)) contains mean coefficients weighted by the inverse standard error (Dichev & Piotroski, 2001, 187).[107] The precision-weighted coefficient of our main variable of interest, $D \times log(\Delta Sale) \times S\_A$, is positive and remains statistically at the 5 (1) percent level significant for total (SG&A) costs (total costs: 0.125, t-val: 2.705; SG&A costs: 0.193, t-val: 2.256).

4.2 The SA-Related Part of Cost Asymmetry and Firm Value

Next, we test if and how the part of resource adjustments attributable to SA (*SA_ASY)* affects firm value. Table III-7, column (1) (column (3)) presents coefficients, including *SA_ASY* estimated on total (SG&A) costs in Eq. (2). Column (2) (column (4)) presents the estimated coefficients on a sample restricted to observations for which the value of *S_A* is equal to one. In all four models, the coefficient on *SA_ASY* shows positive, statistically significant, and ranges from 0.029 to 0.124 (t-val: 1.829 to 2.704). We argue that the effect size is economically meaningful. One increase in standard deviation of *SA_ASY* related to total (SG&A) cost asymmetry results in a 2.691 (1.276) percent increase of *Tobin's q* relative to the sample mean of *Tobin's q.*[108] This provides support for our H2. The coefficients on *DET_ASY*, representing the firm-specific portion of cost asymmetry, are significant (insignificant) and negative for the model specifications related to total (SG&A) costs, consistent with Banker and Byzalov (2014). They argue that asymmetric cost behavior results from diverse management practices, which can have both

[106] With respect to upward adjustments in the event of an increase in the level of activity, there could be competing effects. On the one hand, firms may be able to allocate resources more efficiently (e.g., use slack resources more efficiently) in the event of an expansion of activity. On the other hand, if they identify inconsistencies, they may also choose to deploy more optimal and costly resources (potentially counteracting this effect).

[107] We report precision-weighted averages in line with Kaspereit and Lopatta (2019), as the number of observations included in each regression varies. Consequently, precision varies substantially as well. Hence, equal weighting would result in over- (under-)weighting of estimates obtained from cross-sections including a small (large) number of observations (Dichev & Piotroski 2001, 186). T-statistics in parenthesis are reported corresponding to the precision-weighted average coefficient divided by its standard error.

[108] We calculate theses values based on the full sample estimates.

value-enhancing and destructive consequences, thus decreasing the likelihood of a consistent association with firm value. The coefficients on *SIZE, ROA, DIV, log(Δ Sale), FCF, and BETA* are significant and show the predicted directions. The adjusted R-squared ranges from 0.874 to 0.891, indicating that our model has similar explanatory power to comparable models incorporating firm-fixed effects (e.g., Servaes & Tamayo, 2013).

To further strengthen our results, we consider two alternative definitions of *Tobin's q* following Chung and Pruitt (1994) and Klapper and Love (2004). Table III-8, Panel A presents coefficients employing alternative *Tobin's q* measures on the full sample. Table III-8, Panel B presents coefficients on a sample restricted to observations having SA. Again, all model specifications suggest that the SA-related part of total (SG&A) cost asymmetry is positively associated with firm value, providing further support for our H2.

4.3 Robustness and Sensitivity Tests

We perform robustness tests to validate our main results.[109] To ensure that country-level (e.g., the legal system) or country-year-level factors (e.g., currency exchange rates or political events) do not drive our results, we add country (country-time) fixed effects interacted with the variables *D* and $log(\Delta Sale)$ (Lee et al., 2020).

Prior research also acknowledges differences in ESG and SA across countries (Simnett et al., 2009). Hence, we excluded all countries which introduced mandatory SA through our sample period.[110] Next, we split the sample by countries with high (low) overall adoption rates of SA and find similar results for both subsamples. Further, to alleviate concerns that our results are driven by the overall quantity or quality of assurance services a firm consumes, we include audit fees, abnormal audit fees, and audit quality as additional determinants in Eq. (2).[111] For all tests, our results continue to hold.

[109] The results of the robustness tests are untabulated. All tables available upon request.

[110] Firms in France have had to assure the chosen environmental indicators under the Grenelle II act since 2013. Thus, we exclude French firms from our sample. Under the King Report on Governance for South Africa 2009 (King III), companies listed on the Johannesburg Stock Exchange have to issue an integrated report with assurance. As none of the companies in our sample are listed there, we disregard that. However, our main results remain qualitatively the same if both French and South African companies are excluded according to the respective implementation dates. Italy and Spain have also adopted compulsory assurance in their local implementation of Directive 2014/95 (effective date after our sample period end date).

[111] We estimate abnormal audit fees by applying the audit fee model developed by Ghosh and Lustgarten (2006). As different measures for audit quality in prior literature offer certain advantages and drawbacks, we use various approaches to counteract these differences (DeFond & Zhang, 2014). Hence, we use financial restatements as a proxy for misstatements and unsigned discretionary accruals according to Chi et al. (2017) and abnormal working capital accruals calculated using the methodology of DeFond and Park (2001) as proxies for financial reporting quality and conservatism in line with Cameran et al. (2016).

5. Conclusion

We explore whether the SA process influences managerial decisions (i.e., resource adjustments). Supplemented by field evidence, we hypothesize that SA could result in a better understanding of business processes and committed resources, which may be beneficial in the event of ad-hoc resource adjustments. Our archival findings support this hypothesis, showing that SA is linked to greater resource adjustments in the event of a decline in output levels. We further find that the resource adjustments that are attributable to SA are positively associated with firm value.

Our study contributes to prior literature on SA, in particular revealing internal indirect effects on managerial decision making. Further, we add to literature on cost asymmetry by identifying SA as a factor reducing cost stickiness (with positive effects on firm value). Our results are also relevant for practitioners as we show that SA has internal economic benefits. Thus, our findings are of particular importance for regulators, as we highlight a specific firm-internal benefit of SA resulting from our understanding of the advisory elements in SA. Given the regulatory momentum regarding ESG reporting and SA requirements (e.g., the SEC's proposed rule and the EU CSRD), it is particularly important to provide input for these regulatory debates.

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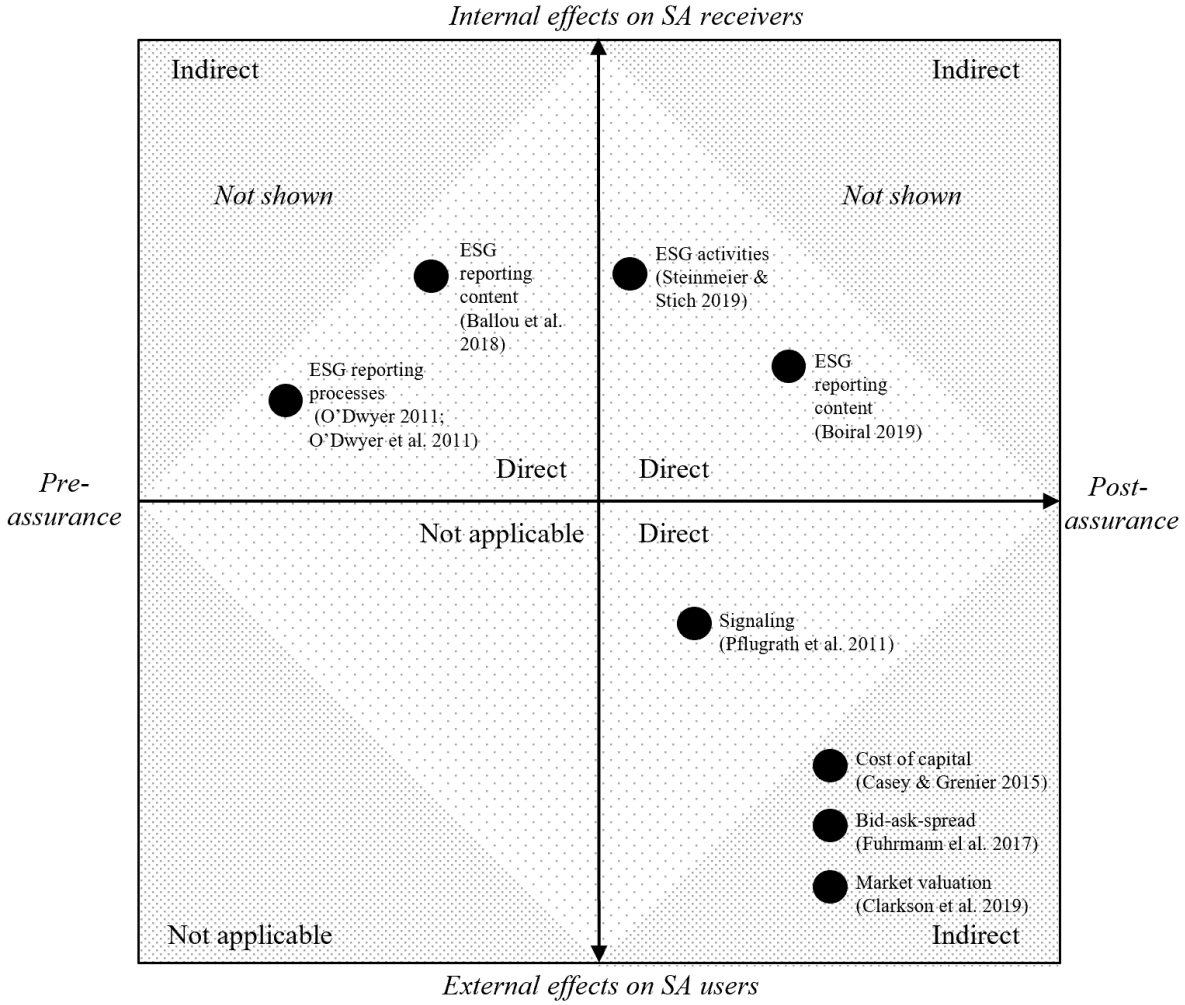
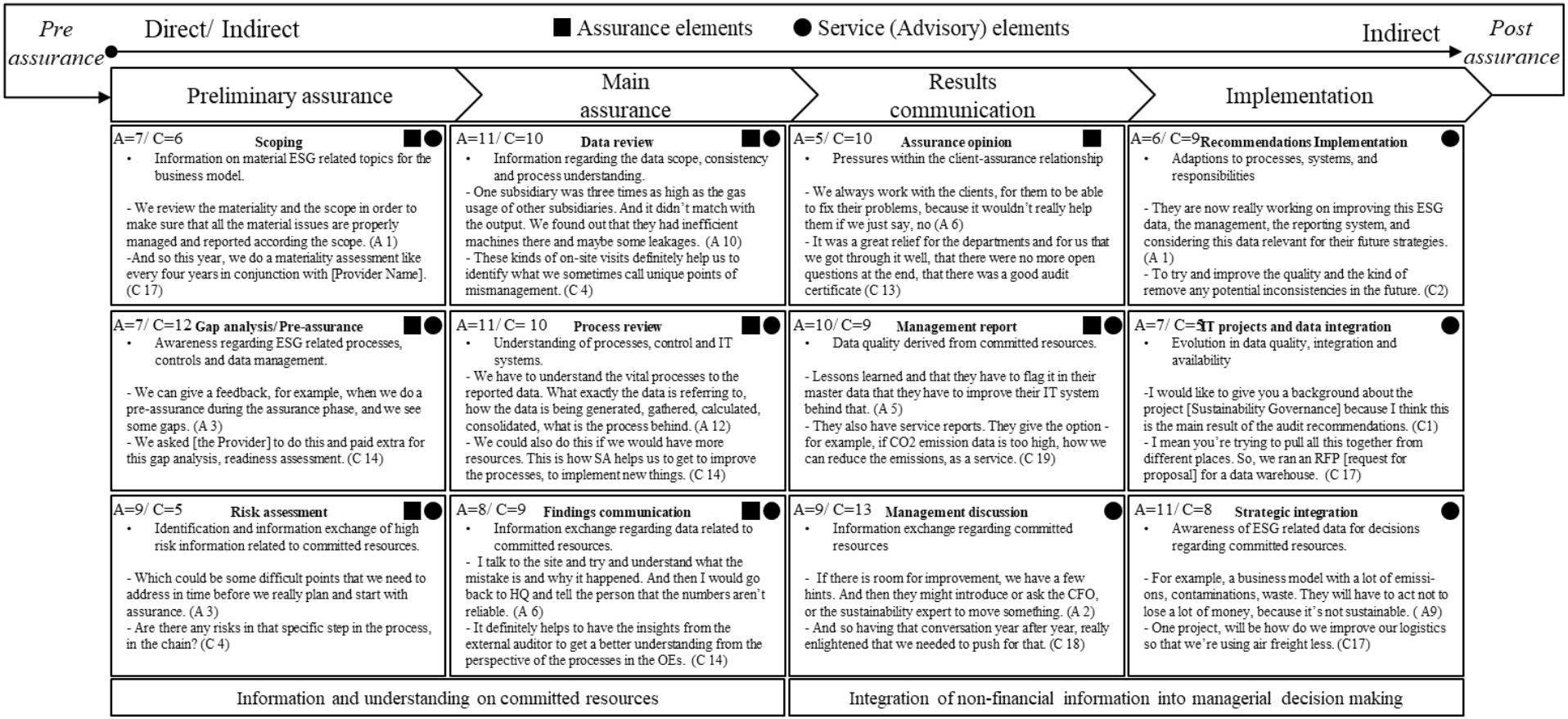
Figure III-1: Effect channels of SA and the SA process in prior literature



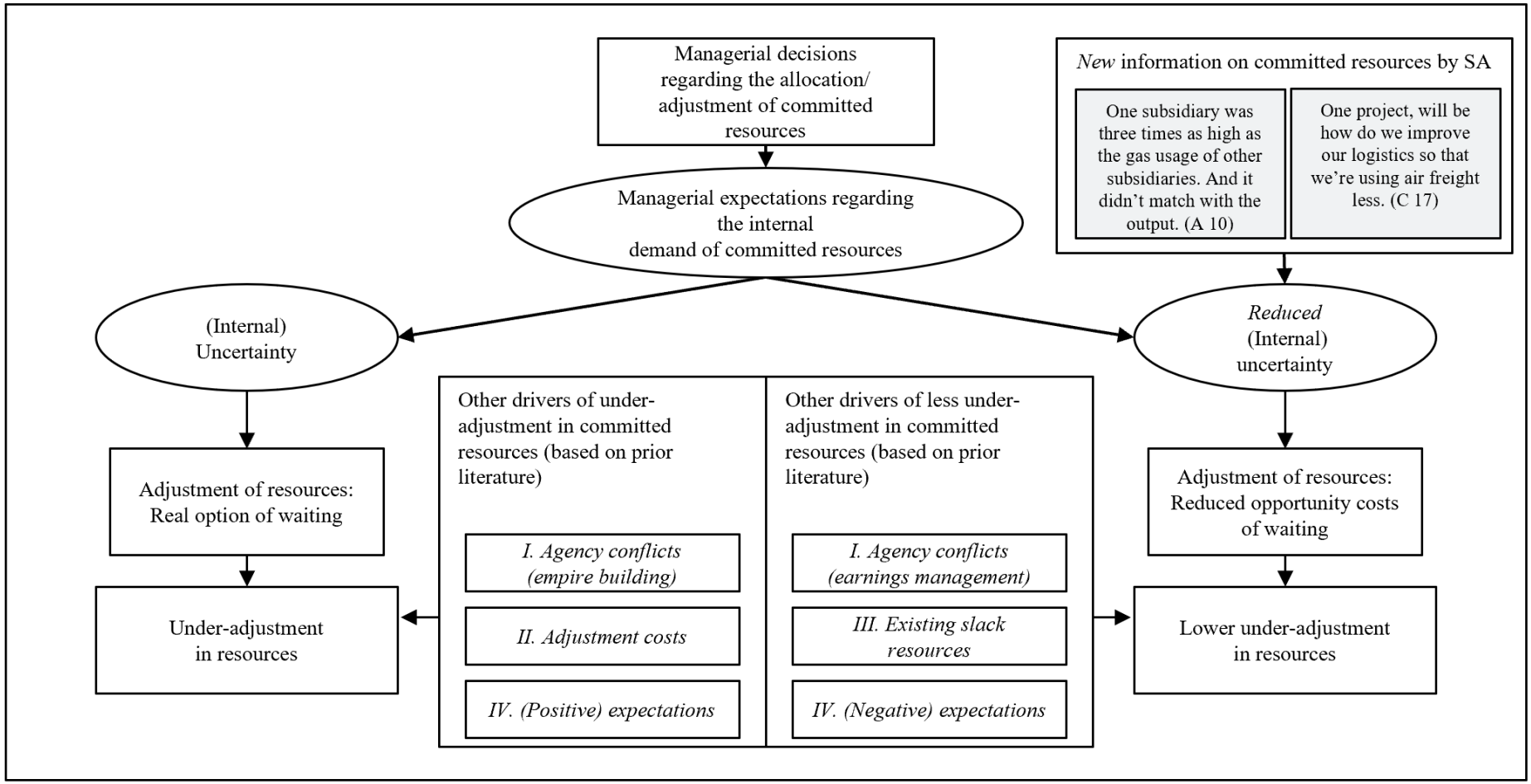
This figure shows the impact channels of SA on *SA receivers* and the external impact on *users* throughout the SA process (from *pre-assurance* to *post-assurance*) via *direct* and *indirect* pathways.

Figure III-2: The insights on committed resources via the SA process



This figure illustrates the impact of the SA process on knowledge and comprehension of the resources committed. A (C) indicates the number of respondents on the assuror side (company insiders) whose statements were assigned to the respective category. The square (circle) denotes a reference provided within the interviews of the perception of the SA as an assurance (service) activity.

Figure III-3: The effect on the SA process on resource commitment



This figure displays the effect of the SA process on managerial decisions regarding the adjustment of committed resources. Further, we include the implications for cost stickiness of the four main drivers (i) agency conflicts, (ii) adjustment costs, (iii) existing slack resources, and (iv) managerial expectations as summarized by Banker & Byzalov (2014).

Table III-1: List of interview evidence

Panel A: Interviews with SA providers

No.	Company	Interviewee	Level	Date	Duration (in mins)
1	P1	A1	Partner	06/14/2021	50
2	P2	A2	Senior Manager	06/242021	51
3	P3	A3	Senior Associate	06/23/2021	38
4	P3	A4	Associate	07/07/2021	43
5	P3	A5	Director	07/07/2021	48
6	P3	A6	Senior Associate	07/14/2021	48
7	P3	A7	Senior Associate	07/20/2021	51
8	P1	A8	Manager	09/20/2021	49
9	P1	A9	Senior Associate	09/16/2021	45
10	P4	A10	Senior Associate	10/29/2021	52
11	P5	A11	Partner	11/11/2021	50
12	P2	A12	Senior Associate	12/22/2021	60
13	P3	A13	Partner	10/19/2022	45
14	P3	A14	Partner	10/19/2022	45
15	(Former P2)	A15	Expert	10/19/2022	45

Panel B: Interviews with corporate insiders

No.	Company	Interviewee	Position	Date	Duration (in mins)
1	F1	C1	Sustainability Management	10/22/2021	52
2	F2	C2	Financial & Regulatory Reporting	11/03/2021	42
3	F2	C3	Sustainability Reporting	11/03/2021	44
4	F3	C4	Sustainability Strategy	11/04/2021	50
5	F4	C5	Sustainability Reporting	11/04/2021	43
6	F5	C6	Sustainability Reporting	11/04/2021	30
7	F5	C7	Sustainability Reporting	11/05/2021	30
8	F6	C8	Sustainability Reporting	11/05/2021	42
9	F7	C9	Sustainability Reporting	11/09/2021	54
10	F7	C10	Sustainability Reporting	11/09/2021	54
11	F7	C11	Financial Reporting	11/09/2021	54
12	F8	C12	Sustainability Management	11/10/2021	47
13	F9	C13	Sustainability	11/10/2021	45
14	F2	C14	Sustainability Reporting	11/16/2021	41
15	F10	C15	Energy & Environment	11/19/2021	33
16	F11	C16	Sustainability Planning and Performance Management	11/22/2021	54
17	F12	C17	Sustainability Management	03/10/2022	50
18	F13	C18	Sustainability Management	03/25/2022	45
19	F14	C19	Sustainability Management	10/04/2022	60
20	F15	C20	Sustainability Management	10/06/2022	60

This table lists the interview participants and provides details on the interviews. Panel A (Panel B) provides details for the SA providers (company insiders) using code names for both the company and the interviewee. We refer to these code names when discussing the interview evidence in our analysis.

Table III-2*:* Variables definition

VARIABLES	Definition
Panel A: Variables employed in the main analysis testing the first hypothesis.	
D	Indicator variable equal to one if the change in sales revenue in the current year was negative, and zero otherwise.
ESG	Overall ESG performance score by Refinitiv ESG. (Refinitiv ESG)
ESGD	ESG disclosure score from Bloomberg. (Bloomberg)
FCF	Operating cash flow (Compustat item OANCF), less common and preferred dividends (DVC and DVP), all scaled by total assets.
ΔGDP	Annual real gross domestic product growth. (World Bank, International Monetary Fund)
LC_IGD	Indicator variable defined as in Dickinson (2011), based on cash flows. It is equal to one if the firm is in the initial, growth, or decline stage, and zero otherwise.
log(ΔSale)	Logarithm change in sales revenue (Compustat item SALE) defined as the ratio of the current year's sales revenue to the prior year's sales revenue.
log(ΔSG&A)	Logarithm change in selling, general, and administrative (SG&A) costs (Compustat item XSGA) defined as the ratio of the current year's SG&A costs to the previous year's SG&A costs.
log(ΔTotal)	Logarithm of the change in total costs (ratio of current year's total costs to prior year's total costs). Total costs are calculated as the difference between sales revenues (Compustat item SALE) and income before extraordinary items (Compustat item IB).
logAINT	Asset intensity defined as the logarithm of the ratio of the current year's total assets (Compustat item AT) to the current year's sales revenue.
logEINT	Employee intensity defined as the logarithm ratio of the current year's number of employees (Compustat item EMP) to the current year's sales revenue.
LOSS_PRIOR	Indicator variable equal to one if the prior year's net income (Compustat item NI) was negative, and zero otherwise. For observations from Compustat Global, NI is defined as operating income (Compustat item IB) + extraordinary items (Compustat item XI) + discontinued items (Compustat item DO).
PPEDEC	Indicator variable equal to one if the change in gross property, plant, and equipment (Compustat item PPEGT) is negative, zero otherwise.
PRSDEC	Indicator variable equal to one if the change in sales revenue in the prior year was negative, and zero otherwise.
S_A	Indicator variable equal to one if a company has sustainability assurance in the current year, and zero otherwise. (Refinitiv ESG)
SMALL_PROFIT	Indicator variable equal to one if the current year's net income is between 0 and 1 percent of total assets, and zero otherwise.
Panel B: Variables employed in the endogeneity analysis.	
ASY	Cost asymmetry measure by Kaspereit and Lopatta (2019) estimated based on the full Compustat sample.
BIG4	Indicator variable equal to one if the financial auditor of the company belongs to one of the four leading accounting firms (i.e., Deloitte, EY, KPMG, PwC) (Compustat item au).
DAC	Unsigned discretionary accruals according to the modified cross-sectional Jones model applied by Chi, Myers, Omer, and Xie (2017). We estimate discretionary accruals based on the full Compustat sample.
LEGAL	Rule of law score developed by Kaufmann et al. (2011) of the country where firm *i* is domiciled in year *t.* (World Bank)
LEV	Ratio of total liabilities (Compustat items DLC and DLTT) divided by total assets.
ROA	Ratio of operating income (Compustat item IB) to lagged total assets.

Cont. Table III-2

SA_MEDIA	Logarithm of the number of articles in the Factiva news database containing the keywords "sustainability audit," "sustainability assurance," "CSR assurance," "CSR audit," "ESG assurance," "ESG audit," or references to the prominent sustainability assurance standards AA1000 AS, ISAE3000 and ISO 14064 published in countries bordering the country where the company is located with a two-period lag.
SIZE	Natural logarithm of total assets. We converted total assets to US dollars by applying the exchange rate on December 31, 2010.
Panel C: Variables employed in the additional analysis testing the second hypothesis.	
ADV	Advertising expenses (Compustat item XAD) divided by net property, plant, and equipment (Compustat item PPENT).
BID_ASK	Bid-ask spread defined as the annual mean of the daily bid-ask spread for each firm-year observation. The daily bid-ask spread is defined as the closing ask-price minus the closing bid price to the mean of the closing bid- and the closing ask-price (Datastream items PB and PA).
BETA	Beta coefficients are obtained by regressing daily company stock returns from the current calendar year on market returns, where we require at least 200 return observations (Datastream).
CAPINT	Capital intensity calculated as gross property, plant, and equipment divided by total assets.
DET_ASY	Cost asymmetry measure by Kaspereit and Lopatta (2019), calculated with the coefficients from Eq. (2) in the original model (i.e., $\widehat{\mu_0} + \widehat{\sum \mu_n DET_{i,t}}$) estimated by GICS sectors.
DIV	Dividends paid (Compustat item DVC and DVP) divided by the market value of equity (Datastream item MV).
ESG_ASY	*ESG_ASY* is the part of total (SG&A) total cost asymmetry related to ESG performance. It is defined as the coefficient on $D \times \log(\Delta Sale) \times ESG$ from Eq. (2) multiplied by ESG.
ESGD_ASY	*ESGD_ASY* is the part of total (SG&A) total cost asymmetry related to ESG disclosure. It is defined as the coefficient on $D \times \log(\Delta Sale) \times ESGD$ from Eq. (2) multiplied by ESGD.
EPSILON	Observation specific residual obtained from rolling five-year regressions of the model in Eq. (2) by GICS sector.
GOV	Governance score. (Refinitiv ESG)
MKT	Sales revenue divided by total industry sales, based on four-digit industry SIC codes. Sales converted to US dollars by applying the exchange rate on December 31, 2010.
R&D	Research and development expenses (Compustat item XRD) divided by sales revenue.
SA_ASY	*SA_ASY* is the part of total (SG&A) total cost asymmetry related to SA. It is defined as the coefficient on $D \times \log(\Delta Sale) \times S\_A$ from Eq. (1) multiplied by *S_A (*i.e., $\widehat{\mu_1} S\_A_{i,t}$).
Tobin's q	Tobin's q defined as total assets plus the market value of equity (Datastream item MV), less book value of common equity (Compustat item CEQ), and deferred taxes (Compustat item TXDB), all scaled by total assets (Compustat item AT).
Tobin's q (Chung & Pruitt, 1994)	Tobin's q defined as total debt (Compustat items DLC and DLTT) plus liquidation value of preferred stock (Compustat item PSTKL) plus the market value of equity (Datastream item MV), all scaled by total assets (Compustat item AT).
Tobin's q (Klapper and Love, 2004)	Tobin's q defined as the market value of equity (Datastream item MV) plus total liabilities (Compustat item LT), scaled by total assets (Compustat item AT).

This table presents variable definitions for the variables included in the model testing H1 (Panel A), the endogeneity analysis (Panel B), and the model testing H2 (Panel C).

Table III-3*:* Sample selection and country distribution

Panel A: Sample selection for estimating the effect of SA on cost asymmetry (H1)		
		Observations
(1)	Intersection TR Refinitiv ESG and Compustat annual files (2007–2018) with unique non-financial and not-state-owned firm-year observations reporting in local currency	33,062
(2)	− Less firm-years with missing data on sustainability assurance (SA) in TR Refinitiv ESG database	−21,586
(3)	− Less firm-years with SG&A expenses higher than sales revenue, negative SG&A expenses, or negative sales	− 260
(4)	− Less firm-years with missing accounting data	− 5,579
(5)	− Less firm-years with no coverage for the Bloomberg ESG disclosure score	− 1,958
(6 a)	− Less singleton observations	(− 359)
(7 a)	= Final sample for the test of H1 (Fixed effects model)	= 6,320
Panel B: Sample selection for estimating the relation between the SA-related part of cost-asymmetry and Tobin's q (H2)		
(8)	= Sample for rolling regressions model by GICS sectors	= 6,631
(9)	−Less firm-years for which no coefficient in the rolling regressions can be estimated (firm-years earlier than 2011)	− 1,479
(10)	−Less firm-years with missing data for next period's Tobin's q	− 950
(11)	− Less firm-years with missing accounting and stock price data	− 89
(12)	− Less singleton observations	− 258
(13)	= Final sample for the test of H2	= 3,855

Panel C: Sample distribution across countries for the samples for H1 and H2

	Sample of H1		Sample of H2	
	Observations	Percent	Observations	Percent
Australia	144	0.023	85	0.022
Austria	44	0.007	33	0.009
Belgium	41	0.006	23	0.006
Brazil	109	0.017	80	0.021
Canada	144	0.023	104	0.027
Switzerland	143	0.023	96	0.025
Germany	317	0.050	192	0.050
Denmark	79	0.013	46	0.012
Spain	109	0.017	72	0.019
Finland	162	0.026	120	0.031
France	518	0.082	354	0.092
United Kingdom	539	0.085	300	0.078
Hong Kong	48	0.008	25	0.006
India	101	0.016	68	0.018
Italy	86	0.014	52	0.013
Japan	1,549	0.245	909	0.236
Mexico	58	0.009	43	0.011
Malaysia	50	0.008	34	0.009
Netherlands	108	0.017	74	0.019
Norway	57	0.009	37	0.010
Poland	28	0.004	21	0.005
Portugal	33	0.005	19	0.005
Singapore	45	0.007	35	0.009
Sweden	229	0.036	149	0.039
Turkey	37	0.006	26	0.007
United States	1,203	0.190	657	0.170
South Africa	199	0.031	159	0.041
Other	140	0.022	37	0.010
Total	6,320	1.000	3,855	

The table presents the sample selection criteria for the test of H1 (Panel A) and H2 (Panel B). Panel C shows the distribution of both samples across countries. Other includes all countries that contain fewer than 30 observations in the sample for H1. These include for H1 (H2): Chile, Colombia, Greece, Indonesia, Ireland, Kenya, New Zealand, Peru, Philippines, Russia, Saudi Arabia, and Thailand (Greece and New Zealand).

Table III-4*:* Descriptive statistics

VARIABLES	N	Mean	S.D.	Q1	Median	Q3
Panel A: Descriptive statistics for the variables used in the test of H1						
S_A	6,320	0.732	0.443	0.000	1.000	1.000
log(ΔSale)	6,320	0.019	0.126	-0.033	0.022	0.080
log(ΔTotal)	6,320	0.020	0.138	-0.036	0.021	0.083
log(ΔSG&A)	6,320	0.021	0.137	-0.034	0.020	0.076
logAINT	6,320	0.220	0.516	-0.110	0.193	0.530
logEINT	6,320	-7.278	2.231	-9.550	-6.332	-5.577
PRSDEC	6,320	0.394	0.489	0.000	0.000	1.000
LOSS_PRIOR	6,320	0.095	0.294	0.000	0.000	0.000
FCF	6,320	0.075	0.049	0.045	0.070	0.100
SMALL_PROFIT	6,320	0.054	0.226	0.000	0.000	0.000
LC_IGD	6,320	0.435	0.496	0.000	0.000	1.000
PPEDEC	6,320	0.296	0.456	0.000	0.000	1.000
ΔGDP	6,320	0.015	0.021	0.008	0.017	0.025
ESG	6,320	66.399	12.880	57.590	67.380	75.930
ESGD	6,320	39.828	12.808	31.190	41.150	49.170
Panel B: Descriptive statistics for the variables used in the selection model of the Heckman (1979) correction						
SA_MEDIA	6,320	1.886	1.656	0.000	1.946	3.434
LEGAL	6,320	1.411	0.556	1.358	1.596	1.705
SIZE	6,320	9.281	1.306	8.382	9.219	10.229
LEV	6,320	0.236	0.141	0.135	0.226	0.327
ROA	6,320	0.057	0.063	0.023	0.048	0.083
BIG4_FA	6,320	0.687	0.464	0.000	1.000	1.000
DAC	6,320	0.036	0.034	0.012	0.027	0.049
ASY (Total)	6,320	-0.126	0.206	-0.249	-0.132	-0.020
ASY (SG&A)	6,320	-0.204	0.282	-0.414	-0.231	-0.026
Panel C: Descriptive statistics for the variables used in the test of H2						
Tobin's q	3,855	1.793	1.157	1.071	1.404	2.069
Tobin's q (C & P)	3,909	1.474	1.157	0.741	1.078	1.782
Tobin's q (K & L)	3,909	1.808	1.157	1.077	1.419	2.109
SA_ASY (Total)	3,855	0.088	0.427	-0.015	0.011	0.266
SA_ASY (SG&A)	3,855	0.121	0.715	0.000	0.111	0.365
D_ASY (Total)	3,855	-0.117	1.547	-0.496	-0.050	0.498
D_ASY (SG&A)	3,855	-0.486	1.528	-1.168	-0.328	0.304
ESG_ASY (Total)	3,855	-0.161	1.515	-0.678	-0.242	0.137
ESG_ASY (SG&A)	3,855	0.279	1.327	-0.565	0.077	0.823
ESGD_ASY (Total)	3,855	-0.005	0.738	-0.324	-0.011	0.293
ESGD_ASY (SG&A)	3,855	-0.027	1.322	-0.539	-0.111	0.511
EPSILON (Total)	3,855	-0.001	0.048	-0.020	-0.001	0.017
EPSILON (SG&A)	3,855	0.001	0.084	-0.036	0.000	0.037
S_A	3,855	0.807	0.395	1.000	1.000	1.000
SIZE	3,855	9.279	1.309	8.375	9.211	10.243
DIV	3,855	0.019	0.016	0.003	0.018	0.028
LEV	3,855	0.236	0.139	0.136	0.225	0.325
ROA	3,855	0.055	0.061	0.023	0.048	0.079
CAPINT	3,855	0.640	0.408	0.290	0.587	0.910
log(ΔSale)	3,855	0.020	0.113	-0.033	0.020	0.077
R&D	3,855	0.028	0.048	0.000	0.007	0.033
ADVERT	3,855	0.009	0.040	0.000	0.000	0.000
FCF	3,855	0.072	0.046	0.043	0.069	0.097
MKT	3,855	0.007	0.010	0.001	0.003	0.009
BID_ASK	3,855	0.002	0.003	0.001	0.001	0.003
GOV	3,855	59.061	20.050	43.860	61.070	75.420
ESGD	3,855	42.057	11.850	34.300	42.980	50.620
BETA	3,855	0.943	0.341	0.717	0.924	1.144

This table contains summary statistics for the variables used for the model of H1 (Panel A), the choice model for the Heckman (1979) correction (Panel B), and the model of H2 (Panel C). N is the number of firm-year observations, with S. D. representing the standard deviation of each variable. Q1 and Q3 represent the 25th percentile and 75th percentile of each of the variables. Detailed definitions of all variables can be found in Table 2. All continuous variables are winsorized at the 1st and 99th percentile.

Table III-5: Correlation analysis

Panel A: Pearson correlations for the variables used in the test of H1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) log(ΔSale)														
(2) log(ΔTotal)	0.833*													
(3) log(ΔSG&A)	0.559*	0.542*												
(4) S_A	0.018*	0.016*	0.008											
(5) logAINT	-0.045*	-0.024*	-0.017*	0.121*										
(6) logEINT	0.021*	0.024*	0.022*	-0.117*	0.033*									
(7) PRSDEC	-0.131*	-0.153*	-0.133*	0.008	0.045*	-0.021*								
(8) LOSS_PRIOR	-0.095*	-0.232*	-0.140*	-0.036*	0.053*	-0.021*	0.217*							
(9) FCF	0.131*	0.081*	0.076*	-0.091*	-0.093*	0.110*	-0.110*	-0.133*						
(10) SMALL_PROFIT	-0.053*	-0.037*	-0.046*	0.024*	0.017*	-0.072*	0.069*	0.137*	-0.100*					
(11) LC_IGD	0.188*	0.241*	0.164*	0.016*	0.067*	-0.034*	-0.024*	0.032*	-0.053*	0.027*				
(12) PPEDEC	-0.220*	-0.215*	-0.223*	0.013*	-0.023*	0.025*	0.120*	0.153*	-0.111*	0.016*	-0.197*			
(13) RDGPG	0.270*	0.235*	0.122*	0.072*	0.042*	0.112*	0.001	-0.079*	0.005	-0.071*	0.018*	-0.002		
(14) ESG	-0.004	-0.006	-0.026*	0.219*	0.051*	0.160*	0.023*	-0.036*	0.059*	-0.014*	-0.028*	0.039*	0.042*	
(15) ESGD	-0.031*	-0.038*	-0.043*	0.378*	0.160*	0.028*	0.038*	0.004	-0.051*	-0.014*	-0.039*	0.065*	0.056*	0.435*

Panel B: Pearson correlations for the variables used in the test of H2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(1) Tobin's q		-0.088*	-0.080*	0.146*	0.030	0.001	-0.087*	-0.246*	-0.018	-0.130*	0.654*	-0.205*	0.102*	0.179*	0.210*	0.383*	-0.024	-0.164*	0.059*	0.018	-0.166*
(2) SA_ASY	0.141*		0.104*	-0.050*	-0.451*	0.022	0.082*	0.017	0.044*	0.007	-0.087*	0.085*	-0.108*	-0.123*	-0.050*	-0.049*	0.019	0.044*	-0.024	-0.013	0.050*
(3) D_ASY	0.115*	0.232*		-0.433*	-0.255*	0.011	-0.024	-0.070*	-0.023	0.013	-0.084*	0.070*	-0.021	-0.095*	-0.063*	-0.070*	0.008	0.061*	-0.013	-0.021	0.084*
(4) ESG_ASY	-0.163*	-0.243*	-0.243*		-0.401*	-0.009	0.012	0.077*	0.021	-0.006	0.120*	-0.134*	-0.065*	0.149*	0.112*	0.066*	0.003	-0.089*	0.064*	0.028	-0.162*
(5) ESGD_ASY	-0.010	-0.290*	-0.290*	-0.222*		0.001	-0.001	0.017	0.027	0.025	0.026	0.038*	0.136*	-0.040*	0.035*	0.043*	-0.025	-0.020	0.018	0.012	-0.043*
(6) EPSILON	-0.010	0.002	0.002	-0.005	0.001		0.003	-0.006	-0.026	-0.007	-0.016	-0.023	0.046*	0.002	-0.008	0.004	-0.005	-0.026	-0.007	-0.008	-0.014
(7) S_A	-0.087*	0.101*	0.101*	-0.003	0.035*	0.002		0.231*	0.032*	0.000	-0.060*	0.045*	-0.005	0.056*	-0.057*	-0.068*	0.034*	-0.050*	0.094*	0.284*	-0.072*
(8) SIZE	-0.246*	0.034*	0.034*	-0.048*	0.033*	0.008	0.017		0.061*	0.206*	-0.151*	0.012	-0.046*	0.108*	0.065*	-0.053*	0.299*	-0.299*	0.242*	0.353*	0.116*
(9) DIV	-0.018	-0.059*	-0.059*	-0.100*	0.108*	0.046*	0.020	0.032*		-0.010	0.140*	0.092*	-0.114*	-0.071*	0.038*	-0.179*	-0.019	-0.079*	0.110*	0.047*	-0.054*
(10) LEV	-0.130*	-0.057*	-0.057*	-0.155*	0.147*	0.004	0.028	0.000	0.206*		-0.242*	0.136*	-0.067*	-0.157*	0.118*	-0.088*	0.027	0.032*	0.037*	0.010	0.013
(11) ROA	0.654*	0.074*	0.074*	0.108*	-0.123*	0.009	-0.215*	-0.060*	-0.151*	0.140*		-0.182*	0.216*	0.108*	0.125*	0.434*	0.008	-0.212*	0.048*	0.018	-0.148*
(12) CAPINT	-0.205*	-0.117*	-0.117*	-0.178*	0.219*	-0.007	-0.005	0.045*	0.012	0.092*	0.136*		-0.117*	-0.219*	-0.107*	0.185*	-0.138*	0.141*	-0.013	0.037*	0.085*
(13) log(ΔSale)	0.102*	-0.013	-0.013	0.078*	-0.132*	0.070*	0.022	-0.005	-0.046*	-0.114*	-0.067*	0.216*		0.042*	-0.017	0.147*	0.036*	-0.038*	-0.057*	-0.078*	-0.015
(14) R&D	0.179*	0.292*	0.292*	0.285*	-0.373*	-0.034*	0.030	0.056*	0.108*	-0.071*	-0.157*	0.108*	-0.219*		0.130*	0.086*	-0.042*	-0.169*	0.099*	0.108*	0.048*
(15) ADVERT	0.210*	0.091*	0.091*	0.080*	-0.089*	-0.040*	0.018	-0.057*	0.065*	0.038*	0.118*	0.125*	-0.107*	-0.017		0.089*	0.106*	-0.145*	0.122*	0.016	-0.032*
(16) FCF	0.383*	-0.022	-0.022	0.005	-0.012	0.020	-0.012	-0.068*	-0.053*	-0.179*	-0.088*	0.434*	0.185*	0.147*	0.086*		-0.047*	-0.109*	0.075*	-0.020	-0.060*
(17) MKT	-0.024	0.013	0.013	0.066*	-0.077*	0.013	-0.009	0.034*	0.299*	-0.019	0.027	0.008	-0.138*	0.036*	-0.042*	0.106*		-0.176*	0.068*	0.074*	0.039*
(18) BID_ASK	-0.164*	-0.075*	-0.075*	-0.021	0.059*	0.004	-0.005	-0.05*	-0.299*	-0.079*	0.032*	-0.212*	0.141*	-0.038*	-0.169*	-0.145*	-0.109*		-0.121*	-0.166*	-0.120*
(19) GOV	0.059*	0.053*	0.053*	0.027	-0.054*	-0.012	0.028	0.094*	0.242*	0.110*	0.037*	0.048*	-0.013	-0.057*	0.099*	0.122*	0.075*	0.068*		0.221*	0.058*
(20) ESGD	0.018	0.069*	0.069*	0.044*	-0.051*	0.004	-0.020	0.284*	0.353*	0.047*	0.010	0.018	0.037*	-0.078*	0.108*	0.016	-0.020	0.074*	-0.166*		0.020
(21) BETA	-0.166*	-0.021	-0.021	0.038*	-0.055*	-0.018	0.016	-0.072*	0.116*	-0.054*	0.013	-0.148*	0.085*	-0.015	0.048*	-0.032*	-0.060*	0.039*	-0.120*	0.058*	

Panel A shows the pairwise Pearson correlations of the additional determinants used in the model in Eq. (1) with log($\Delta SG\&A$) and log($\Delta Total$). Panel B shows the pairwise Pearson correlations of the determinants of Tobin's q used in the model in Eq. (2). Included in the lower (upper) triangle are the independent variables calculated based on the regressions on Eq. (1), using log($\Delta Total$) (log(ΔSG&A)) as the dependent variable. Detailed definitions of all variables are given in Table 2. * indicates a significance level of 0.05.

Table III-6*:* Estimation of the impact of SA on cost asymmetry

Panel A: First stage for Heckman (1979) analysis

	DV = S_A				DV=S_A			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SA_MEDIA		0.047***		0.047***		0.046***		0.046***
		(3.033)		(3.033)		(2.905)		(2.905)
LEGAL		-0.107***		-0.107***		-0.105***		-0.105***
		(-2.812)		(-2.812)		(-2.752)		(-2.752)
SIZE		0.090***		0.090***		0.089***		0.089***
		(5.264)		(5.264)		(5.215)		(5.215)
LEV		-0.280**		-0.280**		-0.281**		-0.281**
		(-1.975)		(-1.975)		(-1.987)		(-1.987)
ROA		-0.743**		-0.743**		-0.831***		-0.831***
		(-2.372)		(-2.372)		(-2.631)		(-2.631)
ESG		0.011***		0.011***		0.011***		0.011***
		(6.148)		(6.148)		(6.180)		(6.180)
ESGD		0.038***		0.038***		0.038***		0.038***
		(22.870)		(22.870)		(22.928)		(22.928)
BIG4		-0.594***		-0.594***		-0.597***		-0.597***
		(-10.855)		(-10.855)		(-10.890)		(-10.890)
DAC		-0.652		-0.652		-0.630		-0.630
		(-1.204)		(-1.204)		(-1.162)		(-1.162)
ASY		-0.097		-0.097		-0.161**		-0.161**
		(-1.057)		(-1.057)		(-2.308)		(-2.308)
Observations included		6,320		6,320		6,320		6,320
Pseudo R-squared		0.176		0.176		0.177		0.177
Industry FE		YES		YES		YES		YES

Panel B: Model testing the association of *S_A* on asymmetric cost behavior

VARIABLES		DV = log(ΔTotal)				DV = log(ΔSG&A)			
	Pred	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S_A		0.014***	0.011	0.008	0.007	0.007	0.006	0.009	0.009
		(2.629)	(1.600)	(1.546)	(1.051)	(0.782)	(0.628)	(1.036)	(0.891)
D × S_A		-0.002	-0.002	-0.001	-0.002	-0.002	-0.002	-0.002	-0.002
		(-0.244)	(-0.224)	(-0.102)	(-0.261)	(-0.205)	(-0.186)	(-0.148)	(-0.158)
log(ΔSale) × S_A	**?**	**-0.072**	**-0.076***	**-0.058**	**-0.060**	**-0.210****	**-0.212*****	**-0.284*****	**-0.285*****
		(-1.597)	**(-1.736)**	**(-1.297)**	**(-1.349)**	**(-2.544)**	**(-2.920)**	**(-3.488)**	**(-3.833)**
D × log(ΔSale) × S_A (H1)	**+**	**0.211****	**0.221****	**0.231*****	**0.230*****	**0.419*****	**0.422*****	**0.540*****	**0.541*****
		(2.125)	**(2.221)**	**(2.969)**	**(2.867)**	**(3.249)**	**(3.795)**	**(3.576)**	**(4.535)**
D		0.003	0.003	0.013	0.011	-0.011	-0.011	0.003	0.003
		(0.420)	(0.393)	(0.664)	(0.550)	(-1.015)	(-1.012)	(0.096)	(0.060)
log(ΔSale)		1.048***	1.052***	1.184***	1.236***	0.825***	0.826***	0.699***	0.710***
		(27.121)	(25.818)	(10.557)	(10.620)	(11.399)	(13.510)	(3.004)	(3.073)
D × log(ΔSale)	-	-0.350***	-0.356***	-0.226	-0.329	-0.546***	-0.548***	-0.046	-0.072
		(-3.689)	(-3.567)	(-1.085)	(-1.497)	(-4.865)	(-5.568)	(-0.118)	(-0.183)
log(ΔSale) × logAINT	-			0.012	0.011			0.005	0.005
				(0.211)	(0.194)			(0.079)	(0.085)
log(ΔSale) × logEINT	-			-0.009	-0.008			0.038***	0.038***
				(-1.199)	(-0.940)			(2.691)	(2.866)
log(ΔSale) × PRSDEC	-			-0.014	-0.017			0.185***	0.183**
				(-0.361)	(-0.422)			(2.615)	(2.394)
log(ΔSale) × LOSS_PRIOR	+			-0.067	-0.071			-0.240**	-0.240*
				(-0.695)	(-0.798)			(-2.032)	(-1.694)
log(ΔSale) × FCF	+			-0.786**	-0.782*			-0.270	-0.267
				(-2.244)	(-1.842)			(-0.412)	(-0.369)
log(ΔSale) × SMALL_PROFIT	+			0.097	0.085			0.059	0.057
				(1.216)	(1.024)			(0.520)	(0.463)
log(ΔSale) × LC_ IGD	-			-0.021	-0.013			0.091	0.094
				(-0.489)	(-0.339)			(1.334)	(1.565)
log(ΔSale) × PPEDEC	+			0.071	0.075*			0.070	0.070
				(1.546)	(1.713)			(0.845)	(0.804)
log(ΔSale) × ΔGDP				0.877	0.992			-3.096*	-3.071**
				(0.948)	(0.846)			(-1.701)	(-1.986)
log(ΔSale) × ESG				-0.002	-0.003*			0.003	0.003
				(-1.610)	(-1.835)			(1.192)	(1.572)
log(ΔSale) × ESGD				-0.000	-0.001			0.005	0.005
				(-0.026)	(-0.383)			(1.562)	(1.596)
D × log(ΔSale) × logAINT	-			-0.235**	-0.233***			-0.034	-0.033
				(-2.410)	(-2.948)			(-0.306)	(-0.343)
D × log(ΔSale) × logEINT	-			0.014	0.011			-0.000	-0.001
				(1.082)	(0.822)			(-0.012)	(-0.040)
D × log(ΔSale) × PRSDEC	+			0.076	0.078			-0.166*	-0.164
				(1.108)	(1.079)			(-1.663)	(-1.483)
D × log(ΔSale) × LOSS_PRIOR	+			-0.100	-0.094			0.072	0.073
				(-0.706)	(-0.842)			(0.454)	(0.478)
D × log(ΔSale) × FCF	-			0.801	0.756			-0.053	-0.065
				(1.097)	(0.997)			(-0.047)	(-0.053)
D × log(ΔSale) × SMALL_PROFIT	+			-0.103	-0.078			-0.239	-0.234
				(-1.037)	(-0.708)			(-1.298)	(-1.143)

Cont. Table III-6

D × log(ΔSale) × LC_ IGD	-		-0.236***	-0.239***			-0.116	-0.117
			(-2.798)	(-3.103)			(-1.022)	(-0.989)
D × log(ΔSale) × PPEDEC	+		0.089	0.083			0.345***	0.345***
			(1.185)	(1.080)			(3.138)	(3.041)
D × log(ΔSale) × ΔGDP	-		-2.937**	-3.147**			0.055	0.019
			(-2.015)	(-2.096)			(0.025)	(0.008)
D × log(ΔSale) × ESG	-		0.003	0.004			-0.005	-0.005
			(0.923)	(1.103)			(-1.124)	(-1.308)
D × log(ΔSale) × ESGD	?		-0.004	-0.003			-0.009*	-0.008*
			(-1.239)	(-0.898)			(-1.867)	(-1.958)
logAINT			-0.020*	-0.019			0.008	0.008
			(-1.736)	(-1.379)			(0.482)	(0.525)
logEINT			0.009	0.008			0.011	0.011
			(1.160)	(1.078)			(0.985)	(0.859)
PRSDEC			0.001	0.001			-0.018***	-0.017***
			(0.162)	(0.281)			(-2.709)	(-2.618)
LOSS_PRIOR			-0.101***	-0.097***			-0.024	-0.023
			(-6.752)	(-6.768)			(-1.488)	(-1.377)
FCF			-0.122**	-0.113*			0.067	0.070
			(-1.966)	(-1.859)			(0.767)	(0.894)
SMALL_PROFIT			0.019**	0.020***			-0.016	-0.016
			(2.153)	(2.788)			(-1.294)	(-1.147)
LC_ IGD			0.020***	0.018***			0.002	0.001
			(4.617)	(4.450)			(0.294)	(0.190)
PPEDEC			-0.003	-0.003			-0.021***	-0.020***
			(-0.671)	(-0.726)			(-3.076)	(-2.812)
ΔGDP			-0.274**	-0.300**			0.143	0.136
			(-2.443)	(-1.995)			(0.669)	(0.605)
ESG			0.000	-0.001			0.000	-0.000
			(0.579)	(-1.621)			(0.377)	(-0.177)
ESGD			0.000	-0.003**			-0.001**	-0.001**
			(0.833)	(-2.347)			(-2.052)	(-2.572)
D × logAINT			-0.001	-0.001			-0.007	-0.007
			(-0.070)	(-0.075)			(-0.589)	(-0.561)
D × logEINT			-0.001	-0.001			0.001	0.001
			(-0.593)	(-0.695)			(0.632)	(0.531)
D × PRSDEC			0.003	0.002			0.014	0.014
			(0.538)	(0.389)			(1.537)	(1.252)
D × LOSS_PRIOR			-0.009	-0.010			-0.028	-0.028
			(-0.462)	(-0.516)			(-1.293)	(-1.184)
D × FCF			-0.025	-0.030			-0.149	-0.151
			(-0.340)	(-0.357)			(-1.305)	(-1.390)
D × SMALL_PROFIT			-0.001	-0.001			-0.008	-0.008
			(-0.068)	(-0.096)			(-0.418)	(-0.397)
D × LC_ IGD			-0.008	-0.007			0.003	0.003
			(-1.095)	(-0.893)			(0.321)	(0.405)
D × PPEDEC			0.007	0.008			0.025**	0.025***
			(0.997)	(1.101)			(2.471)	(2.675)
D × ΔGDP			-0.011	0.037			-0.120	-0.108
			(-0.085)	(0.241)			(-0.496)	(-0.416)
D × ESG			0.000	0.000			0.000	0.000
			(0.203)	(0.139)			(0.211)	(0.160)
D × ESGD			-0.000	-0.000			-0.000	-0.000
			(-1.271)	(-1.065)			(-0.415)	(-0.392)
MILLS		-0.044**		-0.156***		-0.013		-0.039
		(-2.313)		(-2.581)		(-0.867)		(-1.374)
Observations	6,320	6,320	6,320	6,320	6,320	6,320	6,320	6,320
Adj. R-squared	0.676	0.676	0.733	0.733	0.324	0.324	0.357	0.357
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel A contains regression results based on the estimation of the choice model in Eq. (1). z-statistics are given in parentheses. The sample consists of 1,059 firms across 40 different countries for the period 2009-2018. Panel B contains regression results based on the estimation of the model in Eq. (2). Pred. contains the expected direction of the coefficients in terms of cost adjustments based on previous literature in the event of a sales increase or decrease. Columns (1) to (4) (columns (5) to (6)) contain the regression coefficients of the model in Eq. (2) with total (SG&A) costs as the cost variable. Columns (1) and (5) contain the coefficients resulting from the model in Eq. (2) excluding the additional determinants of cost asymmetry. The models estimated in columns (2) and (6) add the inverse mill ratio calculated based on the regression coefficients from the corresponding columns in panel A. Columns (3) and (7) contain the regression coefficients of the model in Eq. (2). The models presented in columns (4) and (8) include additionally the inverse mill ratio calculated based on the regression coefficients from the respective columns in panel A. t-statistics are provided in parentheses. Standard errors are clustered at the firm level. The variable of interest for testing H1 appears in bold. Detailed definitions of all variables are provided in Table 2. ***, ** and * indicate significance levels of 0.10, 0.05 and

Table III-7*:* Estimation of the impact of SA on cost asymmetry – Rolling five-year regressions by GICS Sectors

Panel A: First stage for Heckman (1979) analysis			
		DV = S_A	DV=S_A
VARIABLES		(1)	(2)
SA_MEDIA		**0.055****	**0.054****
		(2.501)	**(2.424)**
DETERMINANTS		YES	YES
Observations		6,631	6,631
(mean) Pseudo R-squared		0.269	0.270
Panel B: Model testing the association of *S_A* on asymmetric cost behavior including the inverse Mills ratio			
VARIABLES		DV = log(ΔTotal)	DV = log(ΔSG&A)
	Pred.	(1)	(2)
S_A		0.003	0.010*
		(0.950)	(1.958)
D × S_A		-0.005	-0.005
		(-1.120)	(-0.563)
log(ΔSale) × S_A	?	**-0.046****	**-0.159*****
		(-1.972)	**(-3.194)**
D × log(ΔSale) × S_A (H1)	+	**0.125*****	**0.193****
		(2.705)	**(2.256)**
MILLS		-0.010*	-0.014**
		(-1.652)	(-2.520)
DETERMINANTS		YES	YES
Observations included		6,631	6,631
(mean) Adj. R-squared		0.778	0.459
No. of obs. estimated coefficients		5,152	5,152
Number of cross sections		64	64
Avg. number of obs. in cross section		349	349

Panel A contains regression results based on the estimation of the selection model in Eq. (1) derived from rolling five-year regressions by GICS sector. The sample consists of 1,394 different firms in 42 different countries for the period 2009-2018. Columns (1) and (2) contain the regression coefficients of the model in Eq. (1) with total (SG&A) costs as the dependent variable in the main model in Eq. (2). Columns (1) and (2) report the mean coefficients using their precision averages (weighted by the inverse of their pooled five-year regression standard error) obtained from rolling five-year regressions by GICS sector. The t-statistic reported in parentheses below is equal to the coefficient of the precision average divided by its standard error (Dichev and Piotroski, 2001). Panel B contains regression results based on the estimation of the model in Eq. (2) obtained from rolling five-year regressions by GICS sector. Pred. contains the expected direction of the coefficients in terms of upward and downward cost adjustments. Columns (1) and (2) contain the regression coefficients of the model in Eq. (2) with total (SG&A) cost as the cost variable. Columns (1) and (2) contain the mean coefficients. The variable of interest appears in bold. Detailed definitions of all variables are provided in Table 2. ***, **, and * indicate significance levels of 0.10, 0.05, and 0.01, respectively.

Table III-8*:* Association between the SA-related portion of cost asymmetry and firm value

	DV Eq. (1) = log(ΔTotal)		DV Eq. (1) = log(ΔSG&A)	
	DV = Tobin's q	DV = Tobin's q	DV = Tobin's q	DV = Tobin's q
VARIABLES	(1)	(2)	(3)	(4)
SA_ASY (H2)	**0.113*** **	**0.124** **	**0.032***	**0.029***
	(2.704)	**(2.530)**	**(1.861)**	**(1.829)**
D_ASY	-0.035***	-0.032**	-0.006	-0.014
	(-2.882)	(-2.299)	(-0.779)	(-1.489)
EPSILON	0.270	0.279	-0.056	-0.025
	(1.398)	(1.377)	(-0.679)	(-0.272)
ESG_ASY	-0.067***	-0.063***	-0.005	-0.014
	(-3.934)	(-3.353)	(-0.492)	(-1.225)
ESGD_ASY	0.009	0.021	0.014	0.006
	(0.378)	(0.769)	(1.202)	(0.563)
S_A	0.045		0.036	
	(0.927)		(0.732)	
SIZE	-0.331***	-0.288**	-0.314***	-0.268**
	(-3.392)	(-2.559)	(-3.190)	(-2.344)
DIV	-2.047**	-2.043*	-1.803*	-1.725
	(-2.235)	(-1.881)	(-1.939)	(-1.565)
LEV	0.049	0.324	0.063	0.332
	(0.169)	(1.052)	(0.221)	(1.080)
ROA	1.495***	1.705***	1.267***	1.482***
	(3.420)	(3.223)	(3.540)	(3.262)
CAPINT	-0.024	0.033	-0.073	-0.025
	(-0.162)	(0.193)	(-0.473)	(-0.143)
log(ΔSale)	0.162**	0.172*	0.176**	0.190**
	(2.019)	(1.750)	(2.193)	(2.001)
R&D	-2.027	0.031	-1.912	0.134
	(-0.667)	(0.011)	(-0.620)	(0.045)
ADV	-0.210	0.732	0.018	0.871
	(-0.119)	(0.452)	(0.010)	(0.510)
FCF	0.669**	0.724*	0.709**	0.745*
	(2.119)	(1.779)	(2.076)	(1.727)
MKT	4.026	0.449	3.710	0.645
	(0.348)	(0.034)	(0.320)	(0.049)
BID_ASK	4.687	5.886	3.931	4.923
	(1.281)	(1.475)	(1.104)	(1.272)
GOV	-0.001	-0.001	-0.001	-0.001
	(-0.619)	(-1.357)	(-1.402)	(-0.619)
ESGD	-0.002	0.001	-0.002	0.000
	(-0.786)	(0.168)	(-0.811)	(0.150)
BETA	0.047	0.086*	0.051	0.088*
	(1.100)	(1.961)	(1.177)	(1.931)
Observations	3,855	3,079	3,855	3,079
Adj. R-squared	0.876	0.891	0.874	0.889
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

The table presents regression results testing the association between the SA-related portion of total (SG&A) cost asymmetry and firm value. Column (1) (column (3)) shows the association between the SA-related part of total (SG&A) cost asymmetry and firm value for the maximum sample for which values for SA-related cost asymmetry and control variables are available. In column (2) (column (4)), the sample is restricted to firm-years with SA in the respective year. Bold indicates the variable of interest of H2. Detailed definitions of all variables are provided in Table 2. t-statistics are reported in parenthesis below. Standard errors are clustered at firm level. ***, **, and * indicate significance levels of 0.10, 0.05, and 0.01, respectively.

Table III-9: Association between the SA-related portion of cost asymmetry and firm value – Alternative Tobin's q measures

Panel A: Association between the SA-related portion of cost asymmetry and firm value (full sample)

	DV Eq. (1) = log(ΔTotal)		DV Eq. (1) = log(ΔSG&A)	
	DV = Tobin's q C & P	DV = Tobin's q K & L	DV = Tobin's q C & P	DV = Tobin's q K & L
VARIABLES	(1)	(2)	(4)	(5)
SA_ASY	**0.106*** **	**0.108*** **	**0.034** **	**0.033***
	(2.633)	**(2.632)**	**(2.028)**	**(1.939)**
D_ASY	-0.034***	-0.035***	-0.005	-0.005
	(-2.757)	(-2.910)	(-0.626)	(-0.671)
EPSILON	0.282	0.257	-0.062	-0.064
	(1.519)	(1.365)	(-0.766)	(-0.774)
S_A	0.055	0.054	0.047	0.046
	(1.162)	(1.142)	(0.996)	(0.976)
Observations	3,909	3,909	3,909	3,909
Adj. R-squared	0.879	0.876	0.878	0.874
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Panel B: Association between the SA-related portion of cost asymmetry and firm value only firm-year with SA in the respective year (restricted sample: *S_A is* equal to one)

	DV Eq. (1) = log(ΔTotal)		DV Eq. (1) = log(ΔSG&A)	
	DV = Tobin's q C & P	DV = Tobin's q K & L	DV = Tobin's q C & P	DV = Tobin's q K & L
VARIABLES	(1)	(2)	(4)	(5)
SA_ASY	**0.120** **	**0.122** **	**0.030***	**0.030***
	(2.540)	**(2.538)**	**(1.886)**	**(1.891)**
D_ASY	-0.030**	-0.031**	-0.013	-0.013
	(-2.118)	(-2.271)	(-1.397)	(-1.381)
EPSILON	0.311	0.287	-0.020	-0.026
	(1.574)	(1.435)	(-0.222)	(-0.277)
Observations	3,111	3,111	3,111	3,111
Adj. R-squared	0.894	0.892	0.893	0.890
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES

The table presents regression results testing the association between the SA-related portion of total (SG&A) cost asymmetry and firm value employing three different definitions for Tobin's q. The first Tobin's q measure follows the definition of Chung and Pruitt (1994). The second Tobin's q measure follows Klapper and Love (2004). Panel A shows the association between the SA-related part of total (SG&A) cost asymmetry and firm value for the maximum sample for which values for SA-related cost asymmetry and control variables are available. In panel B, the sample is restricted to firm-years with SA in the respective year. Bold indicates the variable of interest in H2. Detailed definitions of all variables are provided in Table 2. For both panels t-statistics are reported in parenthesis. Standard errors are clustered at firm level. ***, **, and * indicate significance levels of 0.10, 0.05, and 0.01, respectively.

Part IV: The Moderating Role of CEO Sustainability Reporting Style in the Relationship between Sustainability Performance, Sustainability Reporting, and Cost of Equity

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1. Introduction

"The most fundamental criticism of CSR is that what executives spend on it is other people's—i.e., shareholders'—money. They may mean well, and it may give them satisfaction to write a cheque for hurricane victims or disadvantaged youth, but that is not what they were hired to do. Their job is to make money for shareholders. It is irresponsible for them to sacrifice profits in the (sometimes vain) pursuit of goodness."[112]

Anecdotal evidence such as the quote above suggests that at least some investors and parts of the business press are critical when it comes to strong sustainability engagements on the part of chief executive officers (CEOs). Prior research has shown that CEOs indeed have a significant imprint on a company's decisions regarding sustainability performance (Cronqvist & Yu, 2017; Jiraporn & Chintrakarn, 2013). These individual decisions are based on distinct and unobservable motives (Aguilera et al., 2007). Specifically, CEOs' social values seem to determine their instrumental, relational, and moral motives (Boone et al., 2020). However, the way in which CEOs' social values and motives translate into company-level sustainability is somewhat difficult to assess for outsiders such as investors, as it is hard to determine whether these decisions are driven by self- or other-serving values (Boone et al., 2020).

In this paper, we address the question of whether investors perceive CEOs' sustainability reporting style as a signal, and if they assess company risk as a function of sustainability performance that is moderated by sustainability reporting. This approach is motivated by prior research that suggests that the relationship between sustainability performance and financial performance is not linear. Positive, negative, and non-significant relationships have been documented to date in various contexts (Fujii et al., 2013; McWilliams & Siegel, 2000; Trumpp & Guenther, 2017; Schreck, 2011). Accordingly, the impact of sustainability performance on future financial performance and company risk can be difficult for capital market participants to assess. Therefore, sustainability reporting is essential for companies to reduce information asymmetries on their sustainability activities (Clarkson et al., 2013; Dhaliwal et al., 2011; El Ghoul et al., 2011). Stakeholders may also incorporate other additional publicly available information in their assessment of the true motives underlying a firm's engagement in sustainability (Ogunfowora et al., 2018).

CEOs' engagement in sustainability activities is driven by a mix of instrumental and relational motives. These motives aim at maximizing their own utility function through com-

[112] https://www.economist.com/special-report/2008/01/17/the-next-question, accessed on 06/27/2018.

pensation, job stability, and reputation, as well as moral motives that are purely altruistic beyond genuine self-fulfillment (Aguilera et al., 2007). Since CEOs are guided by their social values and preferences in their decision making regarding sustainability activities (Boone et al., 2020), we hypothesize that their social values and preferences also influence a company's sustainability reporting. This channel is essential to disseminate information about sustainability performance to the external environment (Clarkson et al., 2013).[113] Therefore, it is difficult for capital market participants to evaluate the motives behind sustainability engagement and the implications for their investment in the companies. CEOs might offer some potentially significant insights that affect outsiders' perception of sustainability engagement motives (Ogunfowora et al., 2018). Based on signaling and attribution theory, we postulate that CEOs' sustainability reporting style is a public signal available to investors.[114] Investors then consider this signal in building their assessment of company risk, which in turn is a function of sustainability performance. Therefore, we argue that a deviation from average CEO reporting behavior (relative to a company's baseline level of reporting on sustainability) could be recognized and interpreted by investors as an ambiguous signal. It is thus *ex-ante* unclear whether investors perceive it as a positive or negative signal when evaluating a company's future risk. Since true sustainability performance is partly unobservable to investors and disclosure is the primary source of readily assessable information, we conjecture that they base their perceptions more on CEOs' specific reporting style than on the CEOs' specific sustainability performance style. Overall, (1) we build on the established link between sustainability performance and implied cost of equity (e.g., El Ghoul et al., 2011). Since investors base their perception on available information, we argue that in this relationship, sustainability reporting is essential to reduce information asymmetries and thus moderates the said relationship (2). Based on this illustration we hypothesize that CEO-fixed effects (high/low) moderate the relationship (3). As a result, we expect a three-way moderation between sustainability performance (1), sustainability reporting (2), and CEOs' style of sustainability reporting (3).

[113] We focus on CEOs in our analysis, as they are involved in all major disclosure policy decisions at the corporate level. Sustainability disclosure is admittedly within the responsibility of a company's CEO and CFO (Carroll and Shabana 2010). However, CFOs are more likely to be involved in the development or discussion of disclosure guidance (Brochet, Faurel, and McVay 2011). Still, we also performed our analysis on CFOs (see Appendix 4 Figure 1). Here the signal transmitted to the capital market is significantly weaker than the signal transmitted by the CEO.

[114] Signaling and attribution theory promotes the idea that individuals update their assessment when they receive new signals (Connelly, Certo, Ireland, and Reutzel 2011; Kelley and Michela 1980).

To test our hypotheses, we first construct a measure for sustainability reporting. Michelon et al. (2015) argue that sustainability report quality is a multidimensional construct consisting of quantitative as well as content-based dimensions. Hence, we measure the quality of sustainability reporting on an aggregated level with a self-constructed score comprising five equally weighted different sustainability reporting items from the Asset4 database. These items have been identified as being relevant to investors by prior research (e.g., Plumleeet al., 2015; Reimsbach et al., 2018).

For our empirical test, we employ a two-step research design. First, to estimate whether CEOs significantly contribute to the quality and scope of a company's sustainability reporting, we follow the mover dummy approach outlined in Bertrand and Schoar (2003). We calculate CEO-fixed effects on a sample comprising US companies for all CEOs who became CEO in one of the sample companies within the sample period, left a sample company as CEO, or switched sample companies as CEO in any year during the observation period 2001 to 2019. With this approach, we measure time-invariant fixed effects for each CEO, arguing that a CEO's values and preferences that influence sustainability reporting style are rather stable over time as the orientation of a CEO towards sustainability is most likely a result of their personality and social values (Kang, 2017; Boone et al., 2020). In a second step, to empirically answer whether the specific reporting style attributable to CEOs conveys a signal to investors, we employ the estimated CEO-fixed effects from the first step. By applying a three-way interaction term, we test whether there is a moderating relationship between sustainability performance, sustainability reporting, and CEO-fixed effects as our variables of interest with implied (*ex-ante*) cost of equity (investors' perception of company risk) as the dependent variable.

In the first step of our analysis, we provide novel evidence that CEO-fixed effects significantly explain sustainability reporting at the firm level, which supports our first hypothesis. In the second step, we find that CEOs with a high (low) fixed effect on sustainability reporting are associated with an increase (decrease) in the cost of equity related to a marginal increase in sustainability performance, moderated by sustainability reporting. This supports our Hypotheses 2a/b, underlining the view that capital market participants use CEOs' fixed-effect on sustainability reporting as an indicator of the motives and CEOs' social values underlying the corporate engagement in sustainability. Our findings indicate that high CEO-fixed effects (i.e., driving sustainability reporting) are interpreted as self-serving action. Similarly, low CEO-fixed effects (i.e., lowering sustainability reporting) instead are taken as true motives related to shareholder value maximization through corporate sustainability engagement as a business case. Consequently, investors value sustainability activities perceived to be mainly driven by

instrumental motives as long as they are assessed to add value for shareholders and do not provide CEOs with the possibility to pursue their own ambitions detached from business objectives.

The contribution of our study is twofold. First, our findings add to the literature on the impact of executives on company-level disclosures. Prior studies indicate that executives have an impact on mandatory rather backward-looking financial disclosures (Levy et al., 2018), as well as voluntary financial disclosures (Bamber et al., 2010; Brochet et al., 2011; Yang, 2012; Davis et al., 2015). While voluntary financial disclosures (i.e., conference calls) tend to be short-term in their focus, sustainability reporting is primarily long-term oriented (Dhaliwal et al., 2011). Given that managers follow different time horizons (Brochet et al., 2015), we provide evidence that managers also influence not only voluntary short-term but also long-term disclosure channels. Thus, we provide new evidence, as we show in particular, that their specific style does indeed significantly explain the choice of quality and quantity of voluntary company-level long-term nonfinancial disclosures. By identifying CEOs as drivers of sustainability disclosure, we also add to previous studies that analyze company-specific factors driving sustainability reporting (among many others, Brammer & Pavelin, 2006; Clarkson et al., 2008; Cormier & Magnan, 2003; Dhaliwal et al., 2011, 2014).

Secondly, we contribute to signaling theory literature (e.g., Connelly et al., 2011) and the literature investigating the relationship between sustainability performance and perceived company risk (El Ghoul et al., 2011). While there are many signals to the market in the sustainability context, such as sustainability and ethics programs, corporate disclosures, trustmarks, or sustainability performance (Zerbini, 2017), stakeholders still struggle to evaluate the motives behind such signals as sustainability performance (Ogunfowora et al., 2018). Specifically, by examining the moderating role of CEOs' company-specific sustainability reporting style on the relationship between sustainability performance and shareholders' perceived risk as a particular stakeholder group, we contribute to the literature that considers CEOs signal senders vis-à-vis stakeholders in the sustainability context, which has only been backed up by some experimental evidence to date (Ogunfowora et al., 2018). We suggest that investors incorporate publicly available information about CEOs' impact on company level sustainability reporting into their evaluation of sustainability activities when they assess company risk. We hence add to the literature on the relationship between sustainability performance and risk perception (e.g., El Ghoul et al., 2011) by providing insights into two specific moderators of this relationship, namely sustainability reporting and CEOs' imprint on sustainability disclosure. In particular, we demonstrate how the interaction of sustainability performance and reporting on

the next-period's cost of equity is moderated by how CEOs shape the sustainability reporting style of the company they currently serve.

Our findings show companies how important the CEO role is for implementing a sustainability strategy, which includes the reporting thereon. Our study may also be of use for CEOs in that it demonstrates that they indeed have an influence on company-level sustainability reporting. If they are aware of this influence, they may also be aware that investors could incorporate these differences as signals in their assessments.

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature and develops our research hypotheses. Section 3 describes our methodology, and Section 4 reports our results. Robustness tests are conducted in Section 5. Section 6 concludes the paper.

2. Literature Review and Hypotheses Development

2.1 Sustainability Performance and Cost of Equity

A company's commitment to sustainability may mitigate crisis risks (Coombs & Holladay, 2015), increase customer confidence, boost a company's competitive advantage (Du et al., 2011), and improve organizational processes (Eccles et al., 2014). These benefits contribute to the relationship between sustainability performance and market returns, which has been studied extensively in the context of sustainability performance (e.g., Flammer, 2015). Previous research on companies' commitment to sustainability and how it is evaluated by the market has found divergent results and reported either a positive, negative, or no significant relationship depending on the sample, research design, and setting (Friede et al., 2015; McWilliams & Siegel, 2000). These findings also support the notion that the market perception of sustainability performance is moderated by other factors such as the relationship with customers (Schreck, 2011).

Corporate sustainability engagement may generate competitive advantages, which in turn translate to lower financing costs (Chava, 2014; El Ghoul et al., 2011; Ge & Liu, 2015; Goss & Roberts, 2011). A beneficial impact, especially on the cost of equity, may take place via two possible channels (El Ghoul et al., 2011). First, enhanced sustainability performance reduces the perceived company risk as it increases the stability of future cash flows. More specifically, in negative incidents, stakeholders sanction the affected companies. Such sanctions range from boycotts to challenging business rights and harm reputation and revenues (Godfrey, 2005). As a result, the extent to which a company is penalized varies depending on

how stakeholders perceive the company's intentions (Godfrey, 2005). Activities in sustainability build moral capital that protects a company's reputation and operations when such negative events occur as stakeholders acknowledge such moral capital (Godfrey, 2005; Godfrey et al., 2009; Peloza, 2006). Consequently, commitment to sustainability creates risk management benefits (i.e., a buffer function in case of adverse events) that are recognized by the capital market (Kim et al., 2021). Similarly, poor sustainability performance and irresponsible behavior regarding sustainability topics result in increased perceived risk by investors and, consequently, increased cost of capital (Chava, 2014). The second channel is the reduction of information asymmetries through engagement in sustainability, leading to reductions in agency issues (El Ghoul et al., 2011; Lopatta et al., 2016). Additionally, managers who adopt international frameworks (e.g., the UN Guiding Principles on Business and Human Rights), are more likely to follow ethical and moral standards and need less monitoring (Lopatta et al., 2016), which in turn reduces information asymmetries and cost of equity (Jensen & Meckling, 1976).

Dhaliwal et al. (2011) indicate that companies with a strong sustainability performance also have superior reporting on that performance. Hence, disclosure on sustainability performance is essential to convey information to the capital market to increase transparency and reduce information asymmetries (Clarkson et al., 2013). Also, companies with strong sustainability performance have stronger incentives to disclose information on their performance (Richardson & Welker, 2001). Both sustainability performance and reporting lower information asymmetries, which increase overall company value and allow companies to receive debt and equity capital at more favorable conditions (Dhaliwal et al., 2011; Ioannou & Serafeim, 2017; Michaels & Grüning, 2017). In the context of sustainability reporting, the underlying reporting quality of sustainability performance is closely linked to the value relevance of this particular information for investors (Du & Yu, 2021). Given the evidence on the relationship between sustainability performance and the documented effects of reporting thereon, it can be reasonably assumed that these interact with each other in a moderating relationship when it comes to investors' risk perceptions in the capital market, similar to the relationship between sustainability performance and (accounting-based and market-based) financial performance (Schreck, 2011).

2.2 Managerial Values, Preferences, and Sustainability Reporting

According to Aguilera et al. (2007), managers engage in sustainability activities due to instru-

mental, relational, and moral motives, which they incorporate into their decision-making process in descending order and by different weighting (i.e., each manager has their own mix of motives with different relevant importance for each motive). While instrumental motives, according to agency theory (Jensen & Meckling, 1976), are mostly self-serving and based on maximizing shareholder wealth and related managerial compensation (McWilliams & Siegel, 2001), relational motives are based on stakeholder theory and pressure from stakeholders (Clarkson, 1995; Freeman, 2010). Additionally, managers also have personal and moral incentives to increase company-level sustainability performance as they strive for a meaningful existence, as explained by stewardship theory (Davis et al., 1997).

Moreover, CEOs are known to adopt different management decisions (Bertrand & Schoar, 2003; Fee et al., 2013) and to deal with complex situations differently (Hambrick, 2007; Hambrick & Mason, 1984). These styles vary according to various talent characteristics such as general ability and communication, interpersonal, and execution skills (Bolton et al., 2013; Kaplan et al., 2012). However, these differences in style arise not only due to talent characteristics; they are also the result of inborn predispositions as well as past professional and personal (early) life experiences (Benmelech & Frydman, 2015; Bernile et al., 2017; Davidson et al., 2015; Dittmar & Duchin, 2016; Malmendier et al., 2011; Schoar & Zuo, 2017). Moreover, managerial decisions are based on cognitive biases and personal values (Cyert & March, 1963). Most differences in style can be explained by genetically and culturally transmitted preferences and values (Cesarini et al., 2009; Gören, 2017). For instance, Grønhøj and Thøgersen (2009) found that social interactions within families influence individuals' environmental values, concerns, and behaviors, while Alford et al. (2005) found that genetic influences on a person's behavior shape their political reactions. Hereby, the genetic influences are roughly twice as influential as environmental ones.

Managers may have certain personal and moral motives to correct existing imbalances, especially when it comes to corporate engagement in sustainability and social issues (Logsdon & Wood, 2002). Depending on their values, they have multiple unobservable motives to increase sustainability performance that are related to broader interests rather than self-fulfillment (Davis et al., 1997). According to Boone et al. (2020), social values determined by different information-processing affinities help CEOs navigate in their complex decision environments, especially when it comes to engagement in sustainability. They distinguish between other-serving values resulting in intrinsically motivated actions, and self-serving values which result in extrinsically motivated actions such as a personal gain from corporate engagement in sustainability. Consequently, their specific characteristics and values have a significant impact

on their overall action on sustainability at the corporate level (Hambrick & Finkelstein, 1987; Kang, 2017). For instance, Cronqvist and Yu (2017) showed that CEOs who have a daughter shape their company in a more social direction, while Davidson et al. (2019) documented that materialistic CEOs lower firm-level sustainability performance.

Beyond that, CEOs' motives, underlying personal characteristics and values influence corporate transparency and the quality of information disclosed (Bamber et al., 2010; Brochet et al., 2011; Davis et al., 2015). As a result, managers who engage in "off-the-job" behaviors that reflect underlying self-serving values, such as low frugality and legal violations, negatively affect the quality of corporate reporting (Davidson et al., 2015). By analogy, we argue that CEOs influence the reporting based on their underlying motives of sustainability engagement. Thus, to improve their self-image and receive praise, CEOs with self-serving personality traits might use disclosure channels excessively (Marquez-Illescas et al., 2019), in contrast to CEOs without self-serving personality traits who might primarily aim at reducing information asymmetry. On the other hand, CEOs might also have personal incentives to diminish disclosure quality to mask poor sustainability performance, as this might worsen their reputation and career prospects (Cai et al., 2020; Wang et al., 2018). Hence, we expect CEOs' values and motives concerning sustainability and the reporting thereon to shape how companies publicly disclose information on their sustainability performance. Therefore, we formulate our first hypothesis as follows:

Hypothesis 1 (H1). The unobservable values and preferences of a given manager captured with CEO-fixed effects have significant statistical power in explaining company-level sustainability reporting.

2.3 CEOs' Sustainability Reporting Style and Cost of Equity

After testing whether managers have an individual imprint on a company's sustainability reporting through their specific values and preferences, we are interested in whether a CEO's reporting style alters the relationship between sustainability performance and capital market risk perceptions moderated by the reporting thereon.

According to signaling theory, companies send (positive or negative) signals, thereby revealing private information to the capital market. Shareholders assess a company's behavior based on incomplete information, caused by uncertainties regarding quality and intention, and update their perceptions based on the additional information they receive (Connelly et al., 2011). Corporate engagement in sustainability is seen as a sign of a company's quality (Branco

& Rodrigues, 2006; Zerbini, 2017). However, companies have incentives to mimic signals, or even send false signals, that do not reflect a company's true motives (Connelly et al., 2011). Thus, corporate engagement in sustainability may generate ambiguous signals that could be interpreted by the receiver as either positive or negative (Connelly et al., 2011). As the motives (instrumental, relational, and moral) behind companies' engagement in sustainability are barely accessible to the market (Ogunfowora et al., 2018), the signals companies send about sustainability are rather ambiguous and often perceived by outsiders as conflicting (Skarmeas & Leonidou, 2013). To evaluate a signal sender's behavior and intention, additional relevant information is required (Kelley & Michela, 1980).

Signals provided by CEOs offer potentially meaningful insights and additional information that affect stakeholders' perception of a company's sustainability engagement motives (Ogunfowora et al., 2018). We argue that CEOs' style of sustainability reporting, driven by their personal motives and values, is an additional signal that market participants use to evaluate the relationship between sustainability performance and sustainability reporting in their perceptions of risk. Figure IV-1 illustrates the moderating relationship of CEOs' sustainability reporting style on the relationship of sustainability performance and cost of equity moderated by sustainability reporting.

Given this relationship, the unanswered question is how capital market participants evaluate such styles in sustainability reporting. Specifically, we are interested in whether their style is a relevant signal to investors, which we would then expect to moderate the relationship between sustainability performance and sustainability reporting on the cost of equity.

We assume that typical CEOs engage in sustainability due to a mix of instrumental and relational motives and thus provide no meaningful signal with the reporting on these activities. We consider these typical CEOs as the reference group. In addition to these CEOs, CEOs who deviate from this group and base their motives on self- and other-regarding values send a signal to the capital market. Therefore, we distinguish between CEOs who increase the level of reporting, and CEOs who adversely affect the level of sustainability reporting. Since it is difficult to distinguish whether observable actions are motivated by other-serving values to behave altruistically or by self-serving values to enhance the CEOs' personal self-view (Avolio & Locke, 2002; Boone et al., 2020), the signal a CEO transmits to the market by impacting sustainability reporting might be ambiguous. As a result, shareholders may vary in their attribution regarding the true motives of CEOs' reporting styles.

Observing the signal conveyed by a CEO with driving, company-level sustainability

reporting, capital market participants potentially recognize this excessive reporting as stemming from personal motives, far beyond instrumental and relational motives, to maximize shareholder wealth. Alternatively, CEOs may exploit sustainability reporting to distribute information on sustainability performance which enhances their reputation and helps them pursue a personal agenda (Petrenko et al., 2016; Wang et al., 2008). Management research suggests that the relationship of many apparently monotonous positive relationships reach context-specific inflection points after which the relationships often become negative (i.e., follow an inverted U-shape) (Busse et al., 2016; Pierce & Aguinis, 2013). This holds particularly true for the relationship between sustainability performance and financial performance (Fujii et al., 2013; Trumpp & Guenther, 2017). Specifically, at some point the marginal beneficial impact of an increase in sustainability performance on the performance of the company is significantly below the amount that has to be invested for this purpose (Fujii et al., 2013). Thus, capital market participants may perceive a positive impact of the CEO on sustainability reporting as a signal that the inflection point in this relationship has been reached, or that managerial misconduct is becoming more significant with increased corporate social engagement (Wang et al., 2008). They may then infer that CEOs pursue sustainability activities mainly grounded on instrumental motives. However, in the process they do not act in the interest of shareholder value maximization, as CEOs with self-serving values (i.e., materialism) tend to invest in activities that benefit them personally (Davidson et al., 2019). This, in turn, results in an increase in the cost of equity in response to a marginal increase in sustainability performance at a given level of sustainability reporting. Therefore, we formulate our second Hypothesis 2a as follows:

Hypothesis 2a (H2a). If the CEO increases company-level sustainability reporting, there is a positive relationship between sustainability performance and costs of equity, moderated by sustainability reporting.

Similarly, social values and preferences behind a CEO's decision to reduce company-level sustainability reporting are not observable to capital market participants, who may view such a CEO as investing in sustainability only for truly instrumental and relational motives unaffected by personal agendas (i.e., attribute this as a positive signal). Hence, these investments in sustainability activities based on instrumental motives could be viewed as grounded in a genuine business case (Carroll & Shabana, 2010), which means that CEOs in this case are also conducting themselves morally. Hafenbrädl and Waeger (2019) document that signaling sustainability commitment for instrumental reasons and highlighting the sustainability business

case is a superior impression management strategy, since this reduces perceptions of hypocritical behavior. Moreover, the capital market may perceive a decrease in sustainability reporting quality induced by a specific CEO as a signal that there is no overinvestment driven by a CEO's motives for attention (Petrenko et al., 2016; Wang et al., 2008), resulting in a lower perceived risk and accordingly lower cost of equity.

However, one could also argue that other stakeholders (e.g., customers) also perceive only truly instrumental motives for sustainability as negative. This could be penalized by reduced consumer demand (Ellen et al., 2006; Skarmeas & Leonidou, 2013), resulting in lower future cash flows attributed by shareholders as a negative signal. Moreover, a decrease in sustainability reporting related to a CEO could be perceived as a signal for self-serving values and motives. Managers driven by self-serving values such as materialism show lower corporate engagement in sustainability (Davidson et al., 2019), which in turn could also affect reporting thereon. Thus, for CEOs who negatively impact company-level sustainability reporting, we formulate our second Hypothesis 2b as follows:

Hypothesis 2b (H2b). If the CEO reduces company-level sustainability reporting, there is a negative relationship between sustainability performance and costs of equity, moderated by sustainability reporting.

3. Sample and Methodology

3.1 Sample Selection

Sustainability reporting data are taken for all available companies from the US from the Asset4 section of DataStream, but excluding companies from the financial or utilities industries (SIC codes 4900-4999 and 6000-6999).[115] Accounting data are from Compustat North America, return data from CRSP, CEO data from ExecuComp, and analyst and management forecast data are obtained via I/B/E/S. Board characteristics data are taken from Asset4 and BoardEx. We use all company-years from the Asset4 database for which our constructed measure of sustainability reporting is available in a company-year.[116] Our initial sample size consists of 14,181

[115] To ensure that the data quality of Asset4 is sufficiently high, we contacted Thomson Reuters to inquire further about their data processing. According to the information we received, data quality is ensured via both algorithmic as well as human processes. These processes include data entry checks (e.g., built-in error check logics), post-production automated quality check screens (e.g., interrelated data points and variance within year as logic checks; inconsistency/missing data checks), independent audits and feedback sessions with their data production teams, and management reviews with a focus on top areas of concern.

[116] Using the Asset4 database, we expect to have covered most US firms that engage in sustainability reporting. Of 100 hand-collected, randomly selected US firms that are part of our initial sample but are not included in the Asset4 database, only four had published a sustainability report during our observation period.

company-year observations spanning the period 2001 to 2019. Due to missing data, we end up with 7,149 company-year observations comprising 987 distinct companies for the CEO-fixed effects estimation model. The sample for the cost of equity and CEO-fixed effects model is reduced to 1,510 observations and 264 distinct companies. We present the sample selection procedure in Table IV-1.[117]

3.2 Measuring the Quality of Sustainability Reporting

Previous research often considers only standalone sustainability reports (Dhaliwal et al., 2011; Dhaliwal et al., 2014) when assessing the impact of sustainability reporting on investors (e.g., by looking at cost of equity). However, recent research findings indicate that more than the sustainability report itself matters to investors; they also look at whether these reports incorporate non-financial and financial disclosures and whether they comply with international guidelines such as the GRI guidelines (see in detail Reimsbach et al., 2018). We therefore use a self-constructed five-item score to measure the overall quality of sustainability reporting based on the reporting elements that previous literature has identified as relevant to investors. These elements capture both the quantity as well as the content of these reports, with Michelon et al. (2015) arguing that the quality of sustainability reports is a multidimensional construct consisting of both quantitative and content-based subdimensions. Table IV-2 shows the five sustainability reporting elements, of which at least three have to be available,[118] that constitute our sustainability reporting score (*SR*) and indicates on which studies we base those elements.[119]

3.3 CEOs' Style of Sustainability Reporting

Many existing studies on managerial style effects rely on the method developed by Abowd et

[117] Asset4's coverage changed in recent years. In particular, the coverage increased in 2017. To ensure the change in coverage does not drive our results, we repeated our analysis with a sample limited to companies that were in the Asset4 database prior to 2017. For our first and second step, our results (not tabulated) remain qualitatively the same.

[118] Since at least three of the five items must be available for our measure of sustainability reporting, items are assigned a slightly higher weight if not all five items are available (i.e., 0.33 if only three items are available vs. 0.2 if all five items are available). We believe that this methodological choice is reasonable, but we acknowledge that we face a trade-off between sample size and accuracy.

[119] Our measure is superior to the studies that use only a dummy in their research design (Dhaliwal et al., 2014; Dhaliwal et al., 2011), as these studies point out the lack of mapping of dimensions in the quality and extent of sustainability reporting. Furthermore, the adoption of our measure is not limited to Global Reporting Initiative (GRI) standards (Plumlee et al., 2015), as many other reporting standards related to sustainability disclosure exist. Furthermore, our metric captures all dimensions of sustainability reporting, including environmental, social, and governance. For instance, the metric of Clarkson et al. (2013) is limited to environmental reporting under the Environmental Protection Agency's (EPA) Toxic Release Inventory (TRI), which also requires only a limited number of companies to disclose.

al. (1999) (hereafter, the AKM method). However, especially in the case of CEO-firm matched samples, the AKM method is methodologically problematic as the mover/non-mover ratio is typically quite low. In our sample, the ratio is less than one percent.[120] A low mover/non-mover ratio might cause a severe limited mobility bias, i.e., a downward bias in the estimated correlations between company and CEO-fixed effects (Abowd et al., 2003; Andrews et al., 2008). This is not surprising, given that being appointed CEO is presumably the pinnacle of a manager's career, making it likely they will retire after their time as CEO (Cronqvist & Yu, 2017). Hence, we refrain from using the AKM method as our main method to estimate the CEO-fixed effects and instead follow the mover dummy approach of Bertrand and Schoar (2003). For each moving (that is, a future company-changing or departing) CEO, the mover dummy approach estimates a fixed effect after controlling for company-specific time-variant characteristics as well as firm- and time-fixed effects. Given the restricted size of our sample, we modify their methodology and require a CEO turnover event for each company. Therefore, and due to the small number of switching CEOs within the sample, the estimated fixed effects rather capture CEO style conditional on a particular company and might include an underlying company-specific time trend related to sustainability reporting.[121] Nevertheless, to increase confidence in our results, we also employ the AKM method as a validity analysis and still find a significant influence of the CEO on a firm's level of sustainability reporting quality and scope (results tabulated in the Appendix 4 Table IV-1).

To test our first hypothesis and measure the explanatory power of individual CEOs'

[120] We identified 14 movers vs. 1,638 non-movers in our sample.

[121] Unlike Bertrand and Schoar (2003), we impose less strict requirements on CEO movements. We do not require a within- (Asset 4) sample switch of CEOs because such a restriction would result in an insufficient sample size for a multivariate analysis as we can only identify 14 within-sample switches resulting in 117 firm-year observations with estimated CEO-fixed effects related to movers. However, we require a CEO turnover for each company in our sample to, at least partly, disentangle CEOs from firm-fixed effects. Hence, each sample CEO has either become a CEO, left a firm, or switched to another company as CEO during the sample period. Given our methodological choice, we acknowledge that the estimated CEO-fixed effects are more reflective of capturing CEO style as a function of a particular company due to the small number of within-sample switches. For example, if company (a) has CEO (k) and a switch occurs and CEO (k) is replaced by CEO (l), the estimated effect on CEO (l) and company (a) reflects the change in sustainability reporting level relative to CEO (k) on company (a). For this empirical limitation we argue that it is likely to be a signal similar to that which is visible to investors when they try to assess a CEO's sustainability reporting style. Additionally, company-level specific time trends, which are not captured by our set of control variables, are included in the CEO-fixed effect. To illustrate this concern, let's assume a 10-year timeline and a CEO who joined a company in t=6. Whereas the firm-fixed effect captures the baseline level of sustainability reporting quality in t = 1-5, the CEO-fixed effect measures the difference in the level of sustainability reporting quality in t = 6-10, relative to t=1-5. While the year fixed effects capture a general time trend in the quality of corporate sustainability reporting, company-specific time trends not captured by controls remain in the CEO-fixed effect. We acknowledge this as a limitation of our approach. However, we believe that this is the best available empirical strategy, as it is not feasible to estimate this effect in this setting separately and we tried to capture as many alternative channels/determinants of sustainability reporting as we are aware of with our control variables.

style based on social values on a firm's sustainability reporting quality,[122] we benchmark the baseline Model (1a) without CEO-fixed effects model against Model (1b) which includes CEO-fixed effects estimated with the mover dummy approach, apply a firm-cluster robust version of the Vuong test (Vuong, 1989), and hold the sample constant. The model builds on the logistic model of Dhaliwal et al. (2011):

$$SR_{i,t+1} = \alpha + ß_1SP_{i,t} + ß_2SIZE_{i,t} + ß_3LIQUIDITY_{i,t} + ß_4FIN_{i,t} + ß_5ROA_{i,t} + ß_6HHI_{i,t} + ß_7EM_{i,t} + ß_8MFCAST_{i,t} + ß_9LEV_{i,t} + ß_{10}MTB_{i,t} + ß_{11}COEC_{i,t} + ß_{12}GLOBAL_{i,t} + ß_{13}CEOTEN_{k,t} + ß_{14}CEOAGE_{i,k,t} + ß_{15}CFOEXP_{i,k} + ß_{16}GLOBALCOMPACT_{i,t} + ß_{17}EXTERNALASSURANCE_{i,t} + ß_{18}CEO\_POWER_{i,k,t} + ß_{19}CSO_{i,t} + ß_{20}CEO\_DCHAIR_{i,k,t} + ß_{21}BOARD\_CSR\_COMP_{i,t} + ß_{22}BOARD\_LT\_COMP_{i,t} + ß_{23}BOARD\_GENDER\_DIV_{i,t} + ß_{24}BOARD\_INDEPENDENT_{i,t} + \sum_{t=1}^{T-1} Year_t + \sum_{i=1}^{I-1} FIRM_i \; (+ \sum_{k=1}^{K-1} CEO_k) + \varepsilon_{i,t+1}, \quad (1a/b)$$

where *SR* measures the quality of sustainability reporting as defined in *Appendix 1*. We use the next period's value of sustainability reporting, as reporting behavior presumably reacts at a delay to environmental or firm-specific changes. As we analyze annual firm data, and various sustainability reporting items are disclosed at different timepoints throughout the year, *SR* is calculated as the average value of the monthly *SR* for each firm at the end of June of each year.[123]

We discuss our control variables in detail in *Appendix 2*, and briefly outline them in this section. Our starting point is the control variables introduced by Dhaliwal et al. (2011). For instance, we control for sustainability performance *(SP)* (Dye, 1985). Further, we include company-specific controls identified by prior literature to be associated with voluntary disclosure such as size (*SIZE)* (Prado-Lorenzo et al., 2009), profitability (*ROA*) (Dhaliwal et al., 2011), company's share liquidity (*LIQUIDITY*) (Clarkson et al., 2008), net issuance of long-term debt and shares in a period (*FIN*), earnings quality (*EM)* (Dhaliwal et al., 2011), issuance of management forecasts (*MF)* (Dhaliwal et al., 2014), leverage *(LEV)* (Prado-Lorenzo et al., 2009),

[122] We argue that intentions due to baseline instrumental or relational motives are, at least partly, captured by the company- and CEO-level control variables in Model (1b).

[123] We chose the end of June as the dividing point so that both cost of equity as well as the sustainability reporting score are determined for annual periods from June of year t to July of year t+1. However, the results remain qualitatively similar and significant when we set the end of December as the dividing point (67.86 percent of all firm-year observations in our sample have their financial year end at the end of December).

market-to-book ratio (*MTB*), cost of equity *(COEC)* (Dhaliwal et al., 2014),[124] foreign income (*GLOBAL)* (Dhaliwal et al., 2011) and market competition (*HHI)* (Dhaliwal et al., 2011). Additionally, we control for time-variant CEO characteristics such as CEO's tenure (*CEOTEN),* age (*CEOAGE),* and also their prior experience as a CFO (*CFOEXP)* in the company they currently serve (Bochkay et al., 2019; Matsunaga & Yeung, 2008). Further, we add whether a company receives external assurance on its sustainability reporting (*EXTERNALSSURANCE)* (Steinmeier & Stich, 2019), and whether a company has signed the United Nations Global Compact (*GLOBALCOMPACT)* (Cetindamar, 2007).

Further, we control for governance measures regarding the CEO and board composition. Thus, we include a proxy for CEO centricity (*CEO_POWER)* following Bauer et al. (2021), and CEO duality (*CEO_DCHAIR)* (Song &Wan, 2019). Moreover, we add board characteristics such as the percentage of outside directors monitoring the CEO (*BOARD_INDEPENDENT)* (Jo & Harjoto 2011), the sustainability expertise and voice of a chief sustainability officer (*CSO*) (Fu et al., 2020; Gallego-Álvarez & Pucheta-Martínez, 2020), and *BOARD_GENDER_DIV,* the female share on the board (Adams & Ferreira, 2009; Melero, 2011). Additionally, we control for compensation incentives such as whether compensation is tied to a sustainability target (*BOARD_CSR_COMP)* (Tsang et al., 2021), and the maximum time horizon in years for the director's targets to receive full compensation (*BOARD_LT_COMP)* (Mahoney & Thorne, 2005). Lastly, we include time- and firm-fixed effects.[125] We define all variables in Table IV-3. Again, for a more detailed discussion of our control variables, please see *Appendix 2*.

3.4 CEO-Fixed Effects and Future Cost of Equity

In our design choice to test Hypothesis 2a/b, we build on the research design of El Ghoul et al.

[124] We estimate the cost of equity for each company at the end of June of each year following the approach outlined in Hou et al. (2012) and take the mean value of five distinct cost of equity estimates, using both actual earnings numbers as well as analyst forecasts (for a comprehensive explanation of the five different cost of equity measures, see El Ghoul et al. (2011) as well as Hou et al. (2012)). These are the Claus and Thomas (2001) model; the Gebhardt et al. (2001) model; the Gordon and Gordon (1997) model; the MPEG/ Easton (2004) model; and the Ohlson and Juetter-Nauroth (2005) model.

[125] As indicated in Footnote 10, the estimated CEO-fixed effect indicates the impact of the CEO on sustainability reporting on the level of reporting that was influenced by the previous CEO. Since in a case with two CEOs for one company in the sample, the CEO-fixed effects fully explain the firm-fixed effect, we ensured that our statistics software (Stata) omitted the fixed effect of the first CEO for one company in our sample and did not drop the firm-fixed effect.

(2011). Since sustainability performance and cost of equity may be bilaterally interrelated,[126] we follow Dhaliwal et al. (2011) and lead the dependent variable by one period, since the motivating effect of the future (anticipated) cost of equity on sustainability performance and reporting should be weaker than the motivating effect of the current cost of equity. We estimate the corresponding Model (2) as follows:

$$COEC_{i,t+1} = \alpha + ß_1 CEOFE_{i,t} + ß_2 SR_{i,t} + ß_3 SP_{i,t} + ß_4 (CEOFE_{i,t} * SR_{i,t}) + ß_5 (SP_{i,t} * SR_{i,t}) + ß_6 (CEOFE_{i,t} * SP_{i,t}) + ß_7 (CEOFE_{i,t} * SR_{i,t} * SP_{i,t}) + ß_8 BASPREAD_{i,t} + ß_9 VOL_{i,t} + ß_{10} SIZE_{i,t} + ß_{11} BETA_{i,t} + ß_{12} LEV_{i,t} + ß_{13} MTB_{i,t} + ß_{14} LTGROWTH_{i,t} + ß_{15} DISP_{i,t} + \sum_{t=1}^{T-1} Year_t + \sum_{i=1}^{I-1} Firm_i + \varepsilon_{i,t+1.} \quad (2)$$

To verify whether the portion of the level of sustainability reporting attributable to a CEO is perceived by investors as a positive (negative) signal regarding the underlying motives of an increase in sustainability performance, we estimate the relationship of the current period's sustainability performance and related CEO-fixed effects on the next period's level of cost of equity (*COEC)*. We interact *SP* with *SR* (Dhaliwal et al., 2011), as the relationship between sustainability performance and cost of equity seems to depend on a company's sustainability reporting.

CEOFE captures the CEO-fixed effects estimated applying Model (1b). To reduce measurement noise and increase the model's explanatory power, we group the CEO-fixed effects into terciles (quartiles, quintiles as robustness tests with similar results).[127] Consequently, *CEOFE* captures the CEO-fixed effects from Model (1b) transformed to their across-sample tercile rank value. This data transformation also allows us to compare the relationship of sustainability performance on cost of equity for companies that employ a CEO with a high CEO-fixed effect on sustainability reporting with firms employing a CEO with a low CEO-fixed effect on sustainability reporting. Here, the bottom (top) tercile group consists of CEOs equipped with a high (low) CEO-fixed effect on sustainability reporting. As we predict CEOs to affect the relationship between sustainability performance and cost of equity, we interact *SP* with *CEOFE*.

We assume that CEO-fixed effects on sustainability reporting especially matter to investors when they assess companies' sustainability reporting. Hence, we anticipate the coeffi-

[126] High levels of cost of equity have been shown to motivate firms to engage and disclose more on their sustainability performance to lower financing costs. In turn, companies with a better sustainability performance and quality of sustainability disclosures merit a reduced cost of equity.

[127] This is commonly done in empirical accounting research when variables are known to suffer from low measurement accuracy (Ball and Bartov 1996; Bartov, Radhakrishnan, and Krinsky 2000).

cient of the separate variable *CEOFE* to be statistically insignificant. However, due to econometric concerns (outlined in detail in Brambor et al., (2006)), we refrain from excluding *CEOFE* as a separate variable.[128] For the same reasons, we interact all three sustainability-related variables (*CEOFE*, *SP*, and *SR*), resulting in seven interaction term elements. We expect the association between sustainability performance and cost of equity to be altered by CEOs with a high (low) CEO-fixed effect on sustainability reporting. For CEOs with a low CEO-fixed effect on sustainability reporting, we expect a negative association. Considering only CEOs with a high CEO-fixed effect on sustainability reporting, we foresee a positive relationship.[129]

Besides these sustainability-related variables of interest, we employ further control variables based on El Ghoul et al. (2011) as cost of equity is affected by several company-specific factors such as information asymmetries (*BASPREAD*) and stock return volatility (*VOL*) (Gebhardt et al., 2001). We further control for size (*SIZE*), market-to-book ratio (*MTB*), and leverage (*LEVERAGE*) as they influence cost of equity (Fama & French, 1992). Following El Ghoul et al. (2011), we use the market-model beta (*BETA*) to control for whether a firm's share is more volatile than the market. Moreover, there is evidence that cost of equity is affected by a firm's expected long-term growth rate (Gebhardt et al., 2001) and analyst dispersion (Dhaliwal et al., 2005; Gebhardt et al., 2001). Hence, we include the long-term growth rate (*LTGROWTH)* and analyst dispersion (*DISP)* (El Ghoul et al., 2011) and again include firm- and time-fixed effects. All variables are defined in Table IV-3.

4. Main Results

4.1 Descriptive Statistics

Table IV-4, Panel A displays univariate variable-specific statistics for the variables used in

[128] Brambor et. al (2006) recommend including an exogenous variable X not only as part of interaction term X*Z but also as a separate variable, even if the separate variable X is anticipated *ex-ante* to have zero influence on the endogenous variable Y when the other variable Z of the interaction term equals zero. This is because a measurement bias of the other coefficient estimates already emerges once the true coefficient of X is non-zero (not necessarily statistically different from zero). If the true coefficient of X truly equals zero, the estimated coefficient of X would be statistically insignificant and would not cause biased coefficient estimates.

[129] As Figure IV-1 shows, the link between sustainability performance and cost of equity is moderated by sustainability reporting and the specific style of the CEO. This channel could also be analyzed from a different angle. For example, sustainability reporting could also affect sustainability performance, the CEO's sustainability reporting style could also influence sustainability reporting, and sustainability reporting style could also influence sustainability performance. However, we are interested in the relationship between sustainability performance and the cost of equity moderated by reporting and the CEO-fixed effect, as this sequential order is based on theory. Hence, a company has an incentive to report after it attains a certain sustainability performance, and based on this reporting, the information regarding the CEO-fixed effect is formed.

Models (1a) and (1b), and Panel B does the same for Model (2). In our sample for the CEO-fixed effects estimation, the average sustainability reporting score *SR* equals 0.283. All other variables are in line with previous literature except *COEC*, where the average value is slightly below the cost of equity found in other studies (Dhaliwal et al., 2011; Hail & Leuz, 2006).[130] Comparing Panels A and B, the samples are largely comparable regarding financial characteristics such as *LEV*, *MTB*, and *COEC*. We also find similar values across both panels for non-financial characteristics sustainability performance *SP* and sustainability reporting quality *SR*. Table IV-5 shows the Pearson correlations.

4.2 Measuring CEOs' Sustainability Reporting Style

We assume CEOs to significantly influence a firm's sustainability reporting beyond firm-specific and time-fixed effects. To test this, we benchmark Model (1b) with CEO-fixed effects against Model (1a) without CEO-fixed effects. Table IV-6 reports the results.

Models (1a) and (1b) provide quite similar results. All significant coefficients have the same direction. As expected, sustainability reporting quality is motivated by good sustainability performance, high visibility, and stronger pressure (firm size). The higher adjusted R-squared of Model (1b) compared to Model (1a) (61.5 percent vs. 49.3 percent) shows a considerable explanatory power of CEO-fixed effects. Looking at the individual CEO level, we estimate 681 distinct CEO-fixed effects.

To test for the overall significance of CEO-fixed effects in explaining sustainability disclosures at the firm level, we apply the Vuong test for (un)equal explanatory power between two distinct models following the approach for nested models as outlined in Wooldridge (2011) and use firm-clustered standard errors to receive firm cluster-robust Vuong test statistics. According to the test statistics shown in Panel B, Model (1b) with CEO-fixed effects has higher

[130] Our sample includes primarily large companies, as these are more likely to be covered by sustainability databases such as Asset4. Since size and cost of equity are inversely related (Hail & Leuz, 2006), this may explain why our estimates are slightly lower compared to those of Dhaliwal et al. (2016). As we estimated the cost of equity for the entire Compustat, CRSP, I/B/E/S intersection, we compared these measures to the figures reported Dhaliwal et al. (2016). For this sample, the mean of our average cost of equity measure is 9.43, which is quite close to the average cost of equity value reported by Dhaliwal et al. (2016) (cost of equity mean 11.08). The differences in the sample period must also be taken into account when comparing these two means of cost of equity measures. Another consideration is the difference in the risk-free interest rate for the underlying sample periods of Dhaliwal et al. (2016) and our sample. While the average risk-free interest rate (yield of a ten-year government bond) for the 1981-2011 sample period was 6.82 percent, the average risk-free interest rate (yield of a ten-year government bond) for our sample period is lower, with a value of 3.43 percent. Taking this difference into account, the average risk premium (cost of equity – risk-free rate) for our sample and that of Dhaliwal et al. (2016) turn out to be quite similar.

explanatory power than Model (1a) without CEO-fixed effects. The adjusted R-squared equals 61.5 percent in the model with CEO-fixed effects compared to 49.3 percent in the model without. The two-sided Vuong test for a non-zero difference of the two models' explanatory power is significant at the 1 percent level. This finding supports our first hypothesis that CEOs' sustainability reporting style has significant explanatory power in explaining firm-level differences in sustainability reporting.[131]

4.3 CEO-Fixed Effects and Future Cost of Equity

Next, we test the relationship between the CEO-fixed effects, sustainability performance, and sustainability reporting on the next period's levels of cost of equity. Because we employ moderating variables and self-constructed score-variables, we focus on interpreting the direction of the relationships rather than their magnitudes (Hartmann & Moers, 1999). As we employ interaction terms including two continuous variables, the overall magnitude of the relationship of sustainability performance and the significance level thereof depend on the concrete values of sustainability reporting and the CEO-fixed effect tercile. Whether or not the overall relationship remains significant may depend on these values.[132] Beyond displaying the classic results table, we hence analyze the interaction relationships graphically to show the exact significance intervals for all variables that constitute the interaction terms. With only the result table, we would not be able to provide significance intervals for marginal relationships of the interaction term elements (e.g., sustainability performance) as the significance of the marginal relationships is a joint function not only of its coefficient estimate and variance, but also of the other coefficients estimates (SP, SP*SR, SP*CEOFE, SP*SR*CEOFE), variances, and covariances thereof (Aiken el al. 1996). In the case of negative covariances between the coefficients' estimates, insignificant constitutive interaction terms can still result in significance ranges for the

[131] Our measure of CEO reporting style, the estimated CEO-fixed effects, is the sum of observable and unobservable time-varying and time-invariant characteristics. By including observable CEO characteristics in our regression Model (1a/b), such as CEO age or tenure, we attempt to isolate the time-invariant effects for the estimated CEO-fixed effects. We argue that these variables might also capture some time-varying unobservable characteristics such as risk preferences. However, due to our research approach and the limited data availability, this is not fully possible. Therefore, we would like to point out this limitation of our methodology.

[132] The coefficient on the three-way-interaction (SP*SR*CEOFE) is indicated as on average positive but not significant in Table IV-7. According to Brambor et al. (2006), *"Scholars should refrain from interpreting the constitutive elements of interaction terms as unconditional or average effects—they are not. Notice that the reason why multiplicative interaction models capture the intuition behind conditional hypotheses so effectively is because they make the effect of the independent variable X on the dependent variable Y depend on some third variable Z. As a consequence, the coefficient on the constitutive term X must not be interpreted as the average effect of a change in X on Y as it can in a linear-additive regression model." (71-72).*

interaction term elements (Brambor et al., 2006).[133]

Figure IV-2 displays the marginal relationship of sustainability performance on the next period's levels of cost of equity (x-axis) depending on the levels of sustainability reporting (y-axis) and the respective CEO-fixed effect tercile rank. The figure runs from the smallest (0) to the largest (1) possible sustainability reporting score. The dashed (dotted, solid) line presents the relationship between sustainability reporting and cost of equity ("marginal effect") depending on sustainability reporting levels for companies having a CEO in the bottom (middle, top) fixed-effect tercile. Significances are indicated by means of bold lines above the respective line. Thus, for each tercile, the graphic shows for which levels of sustainability reporting the marginal effect of sustainability performance on the next period's cost of equity is significant.

With regard to Hypothesis 2a, we discuss the signal CEOs convey which are appointed to the top tercile (i.e., attributed to having a high CEO-fixed effect). In this case, we find a significant positive relationship between a marginal increase in sustainability performance and the next period's cost of equity for levels of sustainability below a certain level of sustainability reporting ($SR < 0.57$, solid line in Figure IV-2). This supports Hypothesis 2a, which suggests that a positive impact on sustainability reporting by the CEO may be interpreted as a negative signal by the capital market when evaluating the value of a marginal increase in sustainability performance. Thus, the results suggest that the capital market tends to evaluate this investment decision as mainly dominated by instrumental motives beyond shareholder value maximization, so purely self-serving for the CEO and shareholder value decreasing. Alternatively, the market could interpret the CEO-driven increase in sustainability reporting as a negative signal, because the market participants struggle to properly interpret this information, as the overall level of reporting is below a certain required threshold.

This is also in line with a limitation of our analysis, namely that we estimate fixed effects conditional upon a particular company (e.g., CEO (k) for company (a) vs. CEO (l) for company (a)). However, we concede that due to our limitations in methodology, the estimated CEO-fixed effect also transmits a signal to the capital market that might be related to a company-specific time trend with respect to sustainability reporting.[134]

[133] The underlying mechanism is that negative covariances lower the overall standard error of a marginal effect of one of the interaction term elements.

[134] To address the concern that a new CEO is coupled with a company-specific time trend and that this determines the impact on the quality of sustainability reporting rather than the specific CEO, we included dummy variables in Model (1a/b) if a change occurred in the current (last or second last) period. None of the three indicators turned out to be statistically significant (see Appendix 4 Table IV-2). To further test whether sustainability performance is more likely to be affected by a change in leadership which in turn affects sustainability reporting, we interact each of the dummy variables in Model (1a/b) with sustainability performance. Again, none of the coefficients in the estimate of Model 1 were significant (see Appendix 4 Table IV-3).

For the CEOs in the bottom tercile (i.e., attributed to have a low CEO-fixed effect), we document a negative relationship between an increase in sustainability performance and the next period's level of cost of equity for sustainability reporting above a certain level ($SR > 0.25$, dashed line in Figure IV-2). This provides initial evidence for Hypothesis 2b that the market interprets this as a positive signal, suggesting that shareholders perceive investments in sustainability activities based on instrumental motives to maximize shareholder value and thus behaving morally in their interest.

That this relationship is observable once a certain threshold of SR is reached is consistent with market participants who can only estimate and value investments in sustainability if the information on this performance is already reported adequately. For the lower and upper terciles, we find comparatively large significance intervals, while the middle tercile (reference group) shows only a fairly small significance interval for CEOs. We argue that CEOs in the middle tercile do not send a strong signal as their reporting style does not largely differ from that of the company-level baseline. In the interest of clarity, we also report the average coefficients as a results table in Table IV-7. The first column shows the results using tercile ranks of the CEO-fixed effects, the second (third) column shows the corresponding results with qualitatively similar results for our variables of interest compared to the first regression, now using quartile (quintile) rank indicator variables instead. The overall model fit is similar in all three specifications.

Overall, these results are consistent with our general suggestion that CEOs are guided by their social values and preferences that drive their motives to engage in sustainability. Thus, they have a somewhat visible influence (i.e., CEO-fixed effects) on firm-level sustainability reporting which, then again, capital market participants use to assess a company's risk as a function of incremental changes in sustainability performance.

5. Further Analyses and Robustness Tests

In this section, we briefly present our additional tests. We discuss these in detail in *Appendix 3*. We start our additional analyses by first examining how, in particular, certain levels of sustainability reporting moderate the relationship between sustainability performance and next-period cost of equity when CEO fixed effects are high (low). Our results suggest that, especially for CEOs belonging to the top tercile (i.e., CEOs with a high CEO-fixed effect), investors perceive an increase in sustainability performance as a bad signal when the reporting level is below

the annual sample median, suggesting that this reporting level is insufficient to adequately convey the information to the capital market. Second, we analyze how, in particular, legally required (legal) and voluntarily implemented (normative) sustainability activities are moderated by CEO-fixed effects (Harjoto & Jo, 2015). For this purpose, we split the sustainability performance variable into a normative and a legal sustainability performance measure and re-ran our moderation analysis. Our results suggest that CEO sustainability reporting style is particularly important for investors when evaluating normative sustainability activities. Third, we conduct a series of robustness tests to verify our main findings. In particular, we perform placebo tests in which we create artificial CEO-switches within the sample, restrict the sample to CEO changes from the internal pool, and only consider exogenous CEO turnovers in line with Fee et al. (2013). Additionally, we validate our score by randomly weighting items and comparing our measure of sustainability reporting to the length of hand-collected sustainability reports. Overall, our results support the findings of the main analyses. Kindly refer to *Appendix 3* for detailed discussion of all additional analyses and robustness tests and to *Appendix 4* for the corresponding result tables and figures.

6. Conclusion

This paper sheds light on the interplay between sustainability performance, sustainability reporting, and CEO-fixed effects on sustainability reporting and how they are jointly associated with cost of equity. We are particularly interested in how investors incorporate individual CEO-fixed effects on sustainability reporting as additional information as they assess company risk affected by sustainability performance. Our findings suggest that CEO-fixed effects have significant statistical power to explain the quality of sustainability reporting. Further, we use CEO-fixed effects of sustainability reporting to enhance our understanding of the relationship between sustainability performance and cost of equity and to disentangle sustainability reporting levels, which are primarily related to company-level characteristics, from those more closely tied to CEOs.

Our empirical findings indicate that investors recognize the specific style of a CEO as signaling the underlying motives behind corporate engagement in sustainability in their evaluation of future perspectives and risks. In this context, an increase (decrease) in the baseline company-level sustainability reporting results in increasing (decreasing) cost of equity in response to a marginal increase in sustainability performance depending on the levels of report-

ing a firm undergoes. Our results suggest that investors are more likely to perceive sustainability engagement related to increased reporting on it as a negative signal. Hereby, CEO's underlying self-serving values might amplify this reaction as investors could view excessive reporting as mainly serving a CEO's agenda (e.g., through extensive media coverage) at shareholders' expense. Beyond that, investors are more likely to perceive corporate sustainability engagement in the context of tight reporting as pure shareholder value maximization and sustainability engagement as a business case. Subsuming shareholders appreciate sustainability activities perceived as grounded on instrumental motives as long as they are attributed to be shareholder-value increasing (i.e., as long as a CEO's goals aligns with the goals of shareholders).

We contribute to two research strings. First, we show that CEO-fixed effects help to explain a company's quality and scope of sustainability reporting. In doing so, we add to the literature on manager-specific influences on company-level voluntary disclosure. The evidence so far is limited to voluntary financial reporting (Davis et al., 2015). We add to this stream of literature by considering the influence of CEOs on non-financial, rather long-term disclosures. We also add to the body of literature on factors influencing company-level sustainability reporting quality beyond company and industry level determinants (Brammer & Pavelin, 2006; Clarkson et al., 2008; Clarkson et al., 2011; Dhaliwal et al., 2014).

Our second contribution builds on the first. With CEO-fixed effects considered a signal to outsiders (Ogunfowora et al., 2018), we add to the literature on signaling and attribution theory (Connelly et al., 2011). Specifically, we show that investors incorporate CEO-fixed effects on sustainability reporting in their perception of company risk when evaluating company-level sustainability performance, depending on the level of reporting thereon. Our paper thus enhances the understanding of the link between perceived risk and sustainability performance. Lastly, our continuous sustainability reporting score may also be helpful to practitioners and researchers engaging in future explorations of sustainability reporting beyond the sustainability report itself. Its wide availability and ready-to-use character make it appropriate, not only as a variable of research interest, but also as an easy-to-implement control variable in empirical models.

Our study provides some insights into the signals that CEOs send to capital markets through their underlying personal style and value system. However, there are some limitations inherent to this study, particularly due to the limited sample size and the availability of within-sample switches that restrict the estimation of CEO-fixed effects. Specifically, we cannot observe unconditional CEO-fixed effects, as the estimated fixed effect is only relative to a company's reporting level imprinted by its previous CEO. Hence, we acknowledge that the CEO-

fixed effects obtained through our methodology are rather differences between company-level reporting style (imprinted by the prior management style) and the actual CEO-specific reporting style. In addition, we are not fully able to isolate time-invariant CEO characteristics, as additional time-varying but unobservable CEO characteristics could also be included in the estimated CEO-fixed effects. Further, CEO-fixed effects may capture some company-specific and selection effects. Lastly, we want to stress that the estimated CEO-fixed effects could also capture a signal to the capital market that is more related to a company-specific time trend with respect to sustainability reporting. Yet, we find significant results when we only consider exogenous CEO turnovers according to Fee et al. (2013). Therefore, it might be unlikely that unobservable factors (e.g., due to selection) drive our results. That said, we believe our findings are nonetheless meaningful as we are particularly interested in the way the signal of publicly observable CEO reporting styles depending on the level of reporting are processed by investors (who are likely to rely on methodology and data similar to those on which this study is based).

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Figure IV-1: The moderating effect of CEOs' sustainability reporting style and sustainability reporting on the influence of sustainability performance on cost of equity

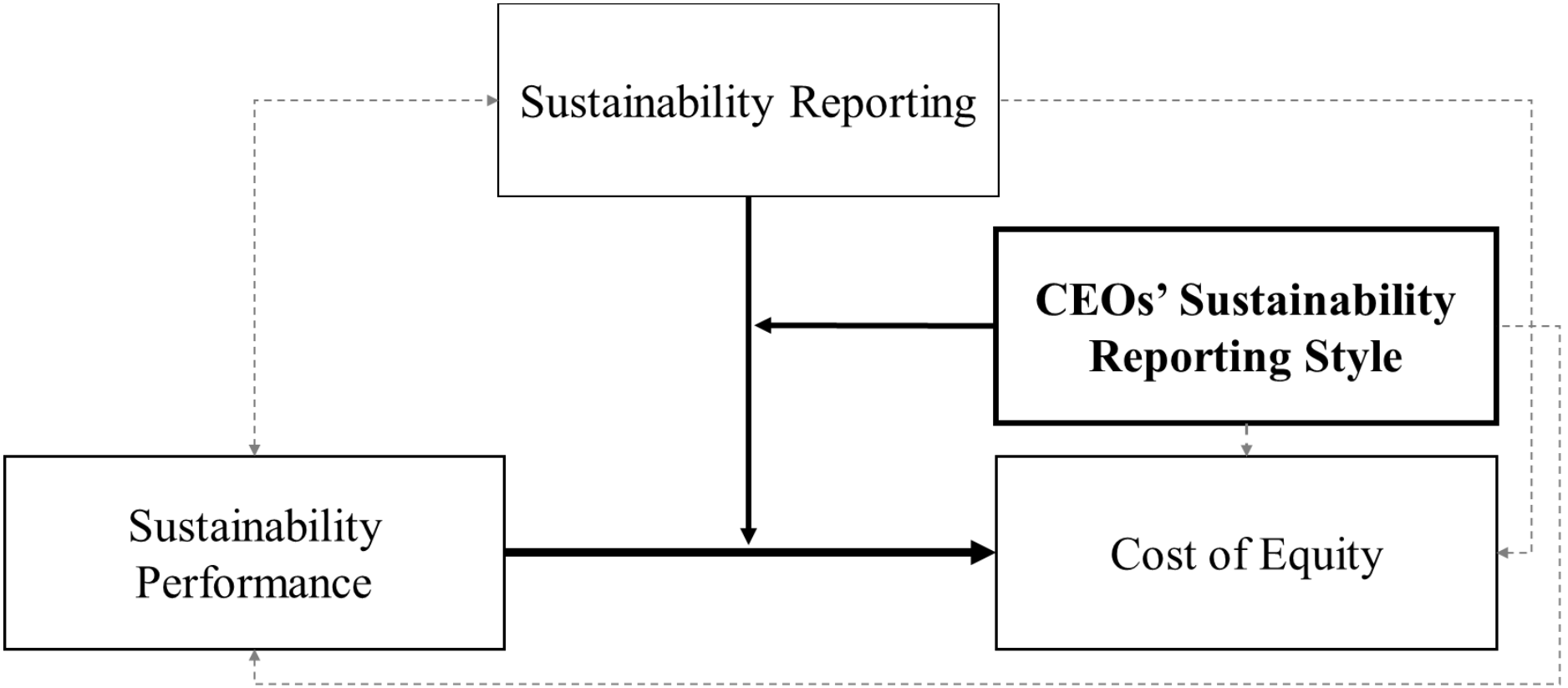
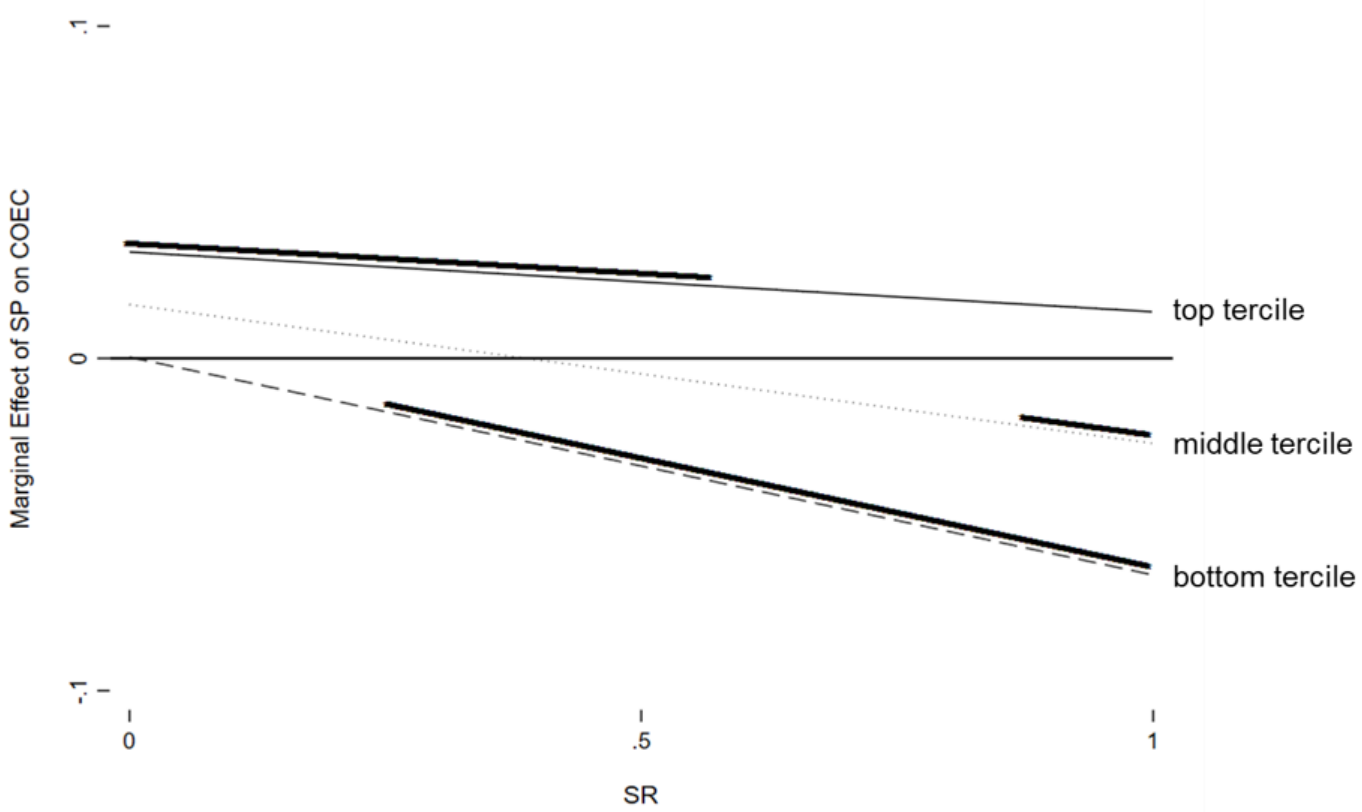


Figure IV-2: Marginal effect of SP on COEC depending on SR and CEO-fixed effects



This figure shows the marginal effect of sustainability performance (*SP*) on next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) as well as sustainability reporting (*SR*). The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on next period's cost of equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on next period's cost of equity at the 10 percent significance level are indicated with a bold line positioned above the respective variables' value combinations.

Table IV-1: Summary of the sample selection procedure

		Reduc-tion	Sample Size
(1)	Asset4 sample excluding financial and utilities industries		14,181
(2)	No sustainability performance data	2,007	12,174
(3)	Missing CEO data	2,910	9,264
(4)	Missing Compustat accounting data	637	8,627
(5)	No CRSP return data	875	7,752
(6)	No cost of equity data	135	7,617
(7	Missing data for board characteristics	468	7,149
(8)	**CEO-fixed effects estimation model**		**7,149**
(9)	Less observations with no CEO-fixed effects (companies without CEO turnover)	4,087	3,062
(10)	Missing I/B/E/S analyst forecasts	1,377	1,685
(11)	Missing values due to using lead variables	175	1,510
(12)	**Cost of equity and CEO-fixed effects model**		**1,510**

Table IV-2: Sustainability reporting score

Item	Name	Description	Related Studies
SRS1	Separate Sustainability Report (Section)	Value 1 if the company publishes a separate sustainability report or a minimum five-page section on sustainability in its annual report; 0 otherwise.	Dhaliwal et al. (2012); Lu, Shailer, and Yu (2017)
SRS2	GRI Report Guidelines	Value 1 if the company has published a sustainability report in accordance with the GRI guidelines; 0 otherwise.	Clarkson et al. (2008); Skouloudis, Evangelinos, and Kourmousis (2010); Clarkson et al. (2013); Plumlee et al. (2015); Kaspereit and Lopatta (2016)
SRS3	Integrated MD&A	Value 1 if the company explicitly integrates financial and extra-financial factors in its management discussion and analysis (MD&A) section in the annual report; 0 otherwise.	Kolk (2003); Reimsbach et al. (2018)
SRS4	Stakeholder Engagement	Value 1 if the company explains how it engages with its stakeholders; 0 otherwise.	Golob and Bartlett (2007); Janney, Dess, and Forlani (2009); Werner (2015)
SRS5	Global Activities	Value 1 if the company's extra-financial report takes the global activities of the company into account; 0 otherwise.	Sobczak and Coelho Martins (2010)
SR	Calculated as the sum of all *SRS* item values, divided by the number of all available *SRS* items. Thus, *SR* ranges between 0 and 1. A minimum of three out of five items is required for *SR*.		

Table IV-3: Variables description

BASPREAD =	Bid/ask spread calculated as the yearly average of the difference between ask and bid price, scaled by the ask price.
BETA =	Annual market model beta using daily return data of the common shares and the value-weighted daily return of all US companies.
BOARD CSR_COMP=	Indicator variable that equals 1 if the senior executives compensation is linked to sustainability targets. If a company changes their compensation scheme within a year we weight the dummy according to the remaining months of the financial year.
BOARD LT_COMP=	The maximum time horizon in years of the board member's targets to reach full compensation.
BOARD GENDER_DIV=	Percentage of females on the board.
BOARD INDEPENDENT=	Percentage of independent board members as reported by the company.
CEOFE =	CEO-fixed effects sorted into tercile ranks according to their yearly across-sample rank. The fixed effects are estimated in Model (1b) using the mover dummy approach.
CEOAGE=	CEO age defined as the natural logarithm plus one of the CEO's age.
CEOTEN=	The tenure of the CEO is calculated as the difference in years between the current year and the date on which the CEO started in the current position.
CEO_DCHAIR=	Indicator variable that equals 1 if the CEO simultaneously chairs the board or the the chairman of the board has been the CEO of the company.
CFOEXP=	Indicator variable that equals 1 if an individual served as CFO in the same company before taking office as CEO; 0 otherwise.
COEC =	Cost of equity following the approach outlined in Hou et al. (2012). We take the average value of all available cost of equity values both using actual earnings numbers (model-based forecasts) as well as analyst's earnings forecast estimated with five different cost of equity measures: Claus and Thomas (2001), Gebhardt et al. (2001), Gordon and Gordon (1997), MPEG/Easton (2004), and Ohlson and Juettner-Nauroth (2005).
CEO_POWER=	Defined as the total CEO pay, divided by the sum of the total pay of the top five executives (Bauer et al., 2021).
CSO=	Indicator variable that equals 1 if the company has a chief sustainability officer on their board; 0 otherwise.
DISP =	Spread of analyst forecasts measured as the logarithm of the standard deviation of analysts' earnings per share forecast scaled by the consensus forecast.
EXTERNAL ASSURANCE=	Indicator variable that equals 1 if the company has commissioned a third party to provide external assurance for its sustainability report; 0 otherwise.
EM =	Earnings management as the absolute value of abnormal accruals estimated with the modified Jones model, following Dechow, Sloan, and Sweeney (1995).
FIN =	Variable that measures a firms' financing activities in a year. Calculated as sale of common and preferred shares, reduced by repurchases of common and preferred shares, plus long-term debt issuance minus long-term debt reduction, all scaled by lagged total assets at the beginning of a year.
GLOBAL =	Indicator variable equaling 1 if a company reports foreign income; 0 otherwise.
GLOBAL COMPACT=	Indicator variable that equals 1 if the company has signed the UN Global Compact; 0 otherwise.

Cont. Table IV-3

HHI =	Herfindahl-Hirschmann Index calculated for each SIC2 industry to proxy for competition intensity in an industry. It is calculated as the sum of the squared shares of sales of the 50 firms with the largest sales within a SIC2 industry. In case there are fewer than 50 firms in an industry in a year, all squared sales-shares are used.
LEV =	Ratio between total debt and total assets at year-end.
LIQUIDITY =	Liquidity of a company defined as the ratio between the number of a firms' shares
traded	during the year and the number of total shares of a company outstanding at year-end.
LTGROWTH =	Long-term growth rate calculated as the difference between two-year and one-year ahead I/B/E/S earnings per share according to analyst consensus forecast.
MFCAST =	Indicator variable that equals 1 if a firm has issued at least one management forecast in year *t*; 0 otherwise.
MTB =	Ratio of market value of common equity divided by the book value of common equity at year-end.
ROA =	Income before extraordinary items scaled by lagged total assets at a year's beginning.
SIZE =	Defined as the natural logarithm of a firm's equity market capitalization at year-end.
SR =	Annual average score of monthly measured quality of sustainability reporting. The score comprises five elements that capture sustainability reporting: SR Report (Section), GRI Report Guidelines, Integrated MD&A, Stakeholder Engagement, Global Activities. Each item is an indicator variable that equals 1 if the item is reported/given for a company and 0 otherwise. The score is calculated as the average of all item values for which at least three items need to be available.
SP =	Asset4 measure that captures the sustainability performance of a firm comprising around 150 sustainability performance indicators based on approximately 375 data points in the fields of environmental, social, and corporate governance performance.
VOL =	Annual standard deviation of the share's (midpoint) price.

This table defines all variables used in the main models. All continuous variables are winsorized at the 1st and 99th percentile.

Table IV-4: Descriptive statistics of regression variables

VARIABLES	N	Mean	S. Dev.	25 %	Median	75 %
Panel A:						
CEO-Fixed Effects Estimation Model						
$SR_{i,t}$	7,149	0.2826	0.3387	0.0000	0.0000	0.6000
$SP_{i,t}$	7,149	0.4138	0.1912	0.2627	0.3793	0.5488
$SIZE_{i,t}$	7,149	8.6643	1.4074	7.6845	8.5189	9.5495
$LIQUIDITY_{i,t}$	7,149	2.5424	1.6420	1.4258	2.0825	3.1322
$FIN_{i,t}$	7,149	-0.0008	0.1381	-0.0607	-0.0174	0.0172
$ROA_{i,t}$	7,149	0.0745	0.0776	0.0349	0.0699	0.1117
$HHI_{i,t}$	7,149	0.0808	0.0620	0.0471	0.0597	0.0830
$EM_{i,t}$	7,149	0.0003	0.0731	-0.0339	-0.0008	0.0312
$MFCAST_{i,t}$	7,149	0.9203	0.2709	1.0000	1.0000	1.0000
$LEV_{i,t}$	7,149	0.2268	0.1612	0.1009	0.2209	0.3312
$MTB_{i,t}$	7,149	4.5542	5.6014	1.9656	3.0495	4.8734
$COEC_{i,t}$	7,149	0.0564	0.0324	0.0356	0.0502	0.0693
$GLOBAL_{i,t}$	7,149	1.6836	0.9151	1.0986	1.7918	2.3979
$CEOTEN_{i,k,t}$	7,149	4.0505	0.1177	3.9703	4.0604	4.1271
$CEOAGE_{k,t}$	7,149	0.7573	0.4287	1.0000	1.0000	1.0000
$CFOEXP_{i,k}$	7,149	0.0817	0.2739	0.0000	0.0000	0.0000
$GLOBALCOMPACT_{i,t}$	7,149	0.0769	0.2665	0.0000	0.0000	0.0000
$EXTERNALASSURANCE_{i,t}$	7,149	0.1077	0.3100	0.0000	0.0000	0.0000
$CEO\_POWER_{i,k,t}$	7,149	0.3214	0.0812	0.2851	0.3229	0.3583
$CSO_{i,t}$	7,149	0.0460	0.2095	0.0000	0.0000	0.0000
$CEO\_DCHAIR_{i,t}$	7,149	0.6819	0.4543	0.0000	1.0000	1.0000
$BOARD\_CSR\_COMP_{i,t}$	7,149	0.2045	0.3752	0.0000	0.0000	0.0833
$BOARD\_LT\_COMP_{i,t}$	7,149	1.1204	1.3921	0.0000	1.0000	2.0000
$BOARD\_GENDER\_DIV_{i,t}$	7,149	16.5102	10.3261	10.0000	15.5550	22.2550
$BOARD\_INDEPENDENT_{i,t}$	7,149	80.1161	12.1647	75.0000	83.3300	88.8900

Cont. Table IV-4

Panel B: Cost of Equity and CEO-Fixed Effects Model						
$COEC_{i,t}$	1,510	0.058	0.027	0.039	0.053	0.073
$SR_{i,t}$	1,510	0.276	0.332	0.000	0.000	0.556
$CEOFE_{i,t}$	1,510	1.964	0.855	1.000	2.000	3.000
$BASPREAD_{i,t}$	1,510	0.001	0.001	0.000	0.001	0.001
$VOL_{i,t}$	1,510	6.073	5.552	2.663	4.428	7.165
$SP_{i,t}$	1,510	0.429	0.191	0.275	0.409	0.565
$SIZE_{i,t}$	1,510	9.127	1.274	8.232	9.009	9.802
$BETA_{i,t}$	1,510	1.091	0.382	0.836	1.067	1.339
$LEV_{i,t}$	1,510	0.209	0.149	0.095	0.207	0.295
$MTB_{i,t}$	1,510	4.244	4.098	2.170	3.280	4.883
$LTGROWTH_{i,t}$	1,510	1.094	1.836	0.151	0.761	1.647
$DISP_{i,t}$	1,510	-3.862	1.014	-4.575	-3.948	-3.263

This table shows descriptive statistics for all variables used in the CEO-fixed effects estimation model (Panel A) as well as in the cost of equity and CEO-fixed effects model (Panel B). All continuous variables are winsorized at the 1st and 99th percentile. All variables are as defined in Table 3.

Table IV-5: Pearson correlation CEO-fixed effects estimation model

Panel A		*[1]*	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*	*[10]*	*[11]*	*[12]*	*[13]*	*[14]*	*[15]*	*[16]*	*[17]*	*[18]*	*[19]*	*[20]*	*[21]*	*[22]*	*[23]*	*[24]*
$SR_{i,t+1}$	*[1]*																								
$SP_{i,t}$	*[2]*	**0.750**																							
$SIZE_{i,t}$	*[3]*	**0.515**	**0.545**																						
$LIQUIDITY_{i,t}$	*[4]*	**-.0550**	**-0.063**	**-0.160**																					
$FIN_{i,t}$	*[5]*	**-0.046**	**-0.091**	**-0.090**	-0.019																				
$ROA_{i,t}$	*[6]*	**0.042**	**0.058**	**0.249**	**-0.036**	**-0.193**																			
$HHI_{i,t}$	*[7]*	**-0.034**	0.010	**-0.033**	**0.117**	**-0.079**	**0.021**																		
$EM_{i,t}$	*[8]*	-0.016	-0.014	-0.001	0.010	**0.105**	**0.100**	-0.010																	
$MFCAST_{i,t}$	*[9]*	**0.119**	**0.170**	**0.137**	**0.050**	**-0.083**	0.018	0.009	**-0.041**																
$LEV_{i,t}$	*[10]]*	**0.124**	**0.089**	**0.054**	**-0.047**	**0.235**	**-0.249**	0.000	-0.003	**0.038**															
$MTB_{i,t}$	*[11]*	**0.038**	**0.035**	**0.171**	**-0.044**	**-0.049**	**0.220**	**-0.036**	0.003	**-0.033**	**0.207**														
$COEC_{i,t}$	*[12]*	**0.077**	**0.025**	**-0.107**	**0.204**	0.010	**-0.133**	**0.061**	**-0.032**	-0.006	**0.128**	**-0.187**													
$GLOBAL_{i,t}$	*[13]*	**0.162**	**0.170**	**0.159**	**-0.065**	**-0.024**	**-0.043**	**-0.235**	-0.016	**0.084**	0.019	0.001	**-0.060**												
$CEOTEN_{i,k,t}$	*[14]*	**-0.089**	**-0.073**	**-0.057**	-0.001	0.011	**0.091**	-0.006	**0.039**	**-0.039**	**-0.098**	0.016	**-0.112**	**-0.077**											
$CEOAGE_{k,t}$	*[15]*	**0.023**	0.019	**0.022**	**-0.072**	0.007	**0.027**	0.003	0.005	**-0.030**	0.009	**-0.027**	-0.001	**-0.041**	**0.386**										
$CFOEXP_{i,k}$	*[16]*	**0.051**	**0.047**	**-0.040**	0.012	0.010	**-0.047**	**0.045**	0.012	**-0.031**	**0.087**	**0.029**	**0.047**	-0.012	**-0.151**	**-0.084**									
$GPACT_{i,t}$	*[17]*	**0.365**	**0.375**	**0.267**	**-0.071**	**-0.029**	0.016	**-0.057**	0.002	**0.058**	0.013	0.016	0.005	**0.114**	**-0.059**	-0.011	0.017								
$ASSURE_{i,t}$	*[18]*	**0.497**	**0.481**	**0.381**	**-0.103**	-0.009	**0.026**	**-0.045**	-0.012	**0.064**	**0.069**	**0.057**	0.001	**0.100**	**-0.047**	**0.029**	**0.046**	**0.365**							
$CEOP_{i,t}$	*[19]*	**-0.081**	**-0.125**	**-0.126**	**-0.061**	**0.032**	**-0.020**	**-0.053**	0.015	**0.027**	**0.056**	-0.013	**0.036**	**-0.022**	**0.028**	**0.024**	-0.011	**-0.071**	**-0.057**						
$CSO_{i,t}$	*[20]*	**0.246**	**0.242**	**0.214**	**-0.048**	-0.016	**0.041**	**0.054**	0.016	**0.040**	**0.029**	**0.035**	0.004	**0.042**	**-0.026**	**0.033**	**0.090**	**0.162**	**0.219**	**-0.062**					
$CDCH_{i,t}$	*[21]*	**0.041**	0.005	**0.136**	**-0.063**	**-0.052**	**0.076**	**0.047**	**-0.026**	**0.023**	**-0.022**	0.005	0.002	**-0.027**	**0.114**	**0.116**	**-0.051**	**0.032**	**0.024**	0.018	**0.038**				
$BCSRC_{i,t}$	*[22]*	**0.312**	**0.357**	**0.232**	0.008	-0.018	**-0.026**	**-0.028**	-0.009	**0.073**	**0.073**	**-0.049**	**0.094**	**0.077**	**-0.024**	**0.028**	**0.028**	**0.161**	**0.233**	**-0.024**	**0.121**	**0.044**			
$BLTP_{i,t}$	*[23]*	**0.049**	**0.127**	-0.004	**0.044**	0.008	**0.032**	**-0.069**	**0.032**	**0.022**	**-0.025**	**0.029**	**-0.096**	0.005	**0.046**	0.017	0.016	**0.021**	**0.042**	**-0.022**	**0.022**	**-0.029**	**0.022**		
$BGDIV_{i,t}$	*[24]*	**0.283**	**0.378**	**0.187**	**-0.060**	**-0.074**	0.005	**0.056**	**-0.025**	**0.078**	**0.059**	**0.079**	**-0.033**	**0.057**	**-0.080**	**0.045**	**0.083**	**0.157**	**0.171**	**-0.078**	**0.106**	0.016	**0.081**	0.005	
$BIND_{i,t}$	*[25]*	**0.244**	**0.333**	**0.099**	**0.038**	**-0.029**	-0.004	**-0.064**	**-0.020**	**0.119**	**0.060**	**0.029**	-0.005	**0.127**	-0.018	0.005	0.018	**0.098**	**0.127**	**0.034**	**0.030**	**-0.033**	**0.165**	0.015	**0.200**

Cont. Table IV-5

Panel B		*[1]*	*[2]*	*[3]*	*[4]*	*[5]*	*[6]*	*[7]*	*[8]*	*[9]*	*[10]*	*[11]*
$COEC_{i,t+1}$	*[1]*											
$SR_{i,t}$	*[2]*	**0.069**										
$CEOFE_{i,t}$	*[3]*	0.024	**0.212**									
$BASP_{i,t}$	*[4]*	**0.087**	**-0.226**	-0.018								
$VOL_{i,t}$	*[5]*	**0.049**	0.007	**-0.063**	**-0.075**							
$SP_{i,t}$	*[6]*	**-0.047**	**0.769**	**0.112**	**-0.272**	-0.030						
$SIZE_{i,t}$	*[7]*	**-0.082**	**0.455**	0.031	**-0.185**	**0.072**	**0.549**					
$BETA_{i,t}$	*[8]*	**0.080**	**-0.121**	**0.057**	**-0.097**	**0.162**	**-0.187**	**-0.237**				
$LEV_{i,t}$	*[9]*	**0.116**	**0.117**	-0.020	**0.076**	**-0.088**	**0.109**	0.030	**-0.157**			
$MTB_{i,t}$	*[10]*	**-0.172**	0.006	-0.021	0.016	**0.068**	**0.063**	**0.196**	**-0.169**	**0.187**		
$LTG_{i,t}$	*[11]*	**0.061**	0.006	**-0.074**	-0.031	**0.229**	0.007	**0.077**	-0.009	0.030	0.015	
$DISP_{i,t}$	*[12]*	**0.219**	-0.001	0.029	**0.132**	0.002	**-0.117**	**-0.197**	**0.391**	0.015	**-0.177**	-0.041

All continuous variables are winsorized at the 1st and 99th percentile. Bold indicates pairwise Pearson correlation at the 10 percent significance level. All variables are as defined in Table 3. For the sake of presentation we abbreviate in this Table *GLOBALCOMPACT* as *GPACT* and *EXTERNALASSURANCE* as *ASSURE, CEO_POWER* as *CEO_P, CEO_DCHAIR* as *CDCH, BOARD_CSR_COMP* as *BCSRC, BOARD_LT_COMP* as *BLTC, BOARD_GENDER_DIV as BGDIV, BOARD_INDEPENDENT* as *BIND, BASPREAD* as *BASP, LTGROWTH* as *LTG*. Panel A shows correlation for the CEO-fixed effects estimation model, whereas Panel B shows correlation for the cost of equity and CEO-fixed effects model.

Table IV-6: CEO-fixed effects estimation

Dependent Variable: $SR_{i,t+1}$	(1)	(2)
Panel A: Regression results		
VARIABLES		
$SP_{i,t}$	0.791***	0.667***
	(0.045)	(0.051)
$SIZE_{i,t}$	0.031***	0.024**
	(0.009)	(0.010)
$LIQUIDITY_{i,t}$	-0.002	-0.002
	(0.004)	(0.004)
$FIN_{i,t}$	-0.016	-0.025
	(0.018)	(0.019)
$ROA_{i,t}$	-0.091*	-0.053
	(0.049)	(0.049)
$HHI_{i,t}$	0.076	0.039
	(0.264)	(0.319)
$EM_{i,t}$	-0.013	0.003
	(0.023)	(0.023)
$MFCAST_{i,t}$	-0.009	0.000
	(0.017)	(0.015)
$LEV_{i,t}$	0.024	0.028
	(0.050)	(0.048)
$MTB_{i,t}$	0.000	-0.000
	(0.001)	(0.001)
$COEC_{i,t}$	0.164	0.052
	(0.102)	(0.095)
$GLOBAL_{i,t}$	0.011	0.017
	(0.019)	(0.018)
$CEOTEN_{i,t-1}$	0.005	0.019*
	(0.005)	(0.011)
$CEOAGE_{t-1}$	-0.087	0.093
	(0.053)	(0.098)
$CFOEXP_{i,t-1}$	-0.006	-0.011
	(0.019)	(0.031)
$CLOBALCOMPACT_{i,t}$	0.011	0.017
	(0.024)	(0.030)
$EXTERNALASSURANCE_{i,t}$	0.051***	0.039**
	(0.016)	(0.017)
CEO_POW-	0.027	0.067
	(0.045)	(0.050)
$CSO_{i,t}$	0.048***	0.014
	(0.018)	(0.017)
$CEO\_DCHAIR_{i,t}$	0.007	0.012
	(0.014)	(0.018)
$BOARD\_CSR\_COMP_{i,t}$	-0.027*	-0.026*
	(0.014)	(0.015)
$BOARD\_LT\_COMP_{i,t}$	-0.008**	-0.007*
	(0.003)	(0.004)
$BOARD\_GENDER\_DIV_{i,t}$	-0.001	-0.001
	(0.001)	(0.001)
$BOARD\_INDEPENDENT_{i,t}$	-0.000	-0.000
	(0.000)	(0.000)
Constant	-0.148	-0.753**
	(0.218)	(0.382)
Observations	7,149	7,149
Adjusted R-squared	0.493	0.615

Cont. Table IV-6

Firm FE	YES	YES
Time FE	YES	YES
CEO FE		YES
Panel B: Cluster-robust Vuong test		
Vuong Z-Statistic:	12.744	
p-Value:	0.000 (***)	

Panel A presents the regression results for Model (1a) without CEO-fixed effects (Column 1) and Model (1b) with CEO-fixed effects (Column 2). All variables are as defined in Table 3. Panel B shows the test statistics for the Vuong test using firm-clustered standard errors with H0: Model (1a) and Model (1b) are equally close to the true specification and H1: Model (1b) is closer to the true specification than Model (1a). Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Table IV-7: Cost of equity and CEO-fixed effects

Dependent Variable: $COEC_{i,t+1}$	(1)	(2)	(3)
VARIABLES			
$CEOFE_{i,t}$	-0.004	-0.002	-0.000
	(0.004)	(0.002)	(0.002)
$SR_{i,t}$	0.064**	0.047*	0.054**
	(0.028)	(0.024)	(0.025)
$SP_{i,t}$	-0.015	-0.006	0.001
	(0.020)	(0.017)	(0.016)
$CEOFE_{i,t} * SR_{i,t}$	-0.020*	-0.010	-0.011*
	(0.011)	(0.008)	(0.006)
$CEOFE_{i,t} * SP_{i,t}$	0.016	0.008	0.004
	(0.010)	(0.006)	(0.005)
$SP_{i,t} * SR_{i,t}$	-0.089*	-0.064	-0.080*
	(0.048)	(0.046)	(0.044)
$CEOFE_{i,t} *SR_{i,t}* SP_{i,t}$	0.024	0.011	0.015
	(0.020)	(0.014)	(0.011)
$BASPREAD_{i,t}$	-0.166	-0.185	-0.192
	(0.833)	(0.841)	(0.837)
$VOL_{i,t}$	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
$SIZE_{i,t}$	0.004	0.004	0.004
	(0.003)	(0.003)	(0.003)
$BETA_{i,t}$	-0.004	-0.004	-0.004
	(0.003)	(0.003)	(0.003)
$LEV_{i,t}$	0.008	0.009	0.008
	(0.009)	(0.009)	(0.009)
$MTB_{i,t}$	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
$LTGROWTH_{i,t}$	-0.001	-0.001	-0.000
	(0.000)	(0.000)	(0.000)
$DISP_{i,t}$	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
CONSTANT	0.025	0.021	0.018
	(0.024)	(0.024)	(0.024)
Observations	1,510	1,510	1,510
Adjusted R-squared	0.626	0.625	0.625
Firm FE	YES	YES	YES
Time FE	YES	YES	YES

This table presents the results for Model (2). The first column presents the effects of levels in Sustainability Performance (*SP*) and Sustainability Reporting (*SR)* on next period's cost of equity (*COEC).* Column 1 presents the effects of CEO-fixed effects on next period's cost of equity (*COEC*). Column 1 presents the results sorting the CEO-fixed effects into terciles, Column 2 (Column 3) as a robustness test into quartiles (quintiles). All variables are as defined in Table 3. Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are clustered by CEO and reported in parentheses below.

8. Appendix

8.1 Measuring the Quality of Sustainability Reporting

In the following, we outline the five elements of our constructed score and link them to previous literature. The sustainability report is the core instrument that firms use to disclose their sustainability performance (Lu et al., 2017), which we capture with the first sustainability reporting score (*SR*) element (*SRS 1 Separate Sustainability Report (Section)*). Previous empirical findings indicate that these standalone reports may have multiple beneficial effects, e.g., better analyst forecast accuracy (Dhaliwal et al., 2012) and more efficient use of cash (Lu et al., 2017).

Severe methodological criticisms of the GRI guidelines notwithstanding (Boiral & Henri, 2017; Fonseca et al., 2014; Moneva et al., 2006), they are often used as a proxy for the level and sometimes even the quality of sustainability reporting, either by applying the original guidelines or by developing an adjusted index based on the GRI guidelines (Clarkson et al., 2008; Clarkson et al., 2013; Kaspereit & Lopatta 2016; Plumlee et al., 2015; Skouloudis et al., 2010). Hence, our second item *SRS2 GRI Report Guidelines* takes into account whether a firm's report is prepared in line with GRI requirements.

Recent studies also indicate that integrated reporting, e.g., combined financial/non-financial disclosures (Lozano & Huisingh, 2011), is value-relevant to investors as it gives them a holistic picture of a firm's overall performance (Kolk, 2003; Reimsbach et al., 2018). Consequently, we also include *SRS3 Integrated MD&A*.

Firms can reduce the dilemmas they face in their attempts to act in a socially responsible manner by engaging in a dialogue with their stakeholders (Nielsen & Thomsen, 2007), which in turn may improve their (future) sustainability performance. Engaging with its stakeholders may also increase a firm's legitimacy (Golob & Bartlett, 2007), which in itself has economic value (Janney et al., 2009) and may also eventually lead to better access to legislators (Werner 2015). Hence, *SRS4 Stakeholder Engagement* indicates whether companies explain how they engage with their stakeholders.

Companies may either report on their sustainability activities only in their home country or globally. As sustainability reports that detail a firm's global activities are expected to be more informative for investors than those with a solely national scope, we integrate *SRS5 Global Activities*, which indicates whether a sustainability report has a global scope (Sobczak & Coelho Martins, 2010).

8.2 CEOs' Style of Sustainability Reporting Control Variables

Here, we would like to outline our control variable set and explain the motivation behind including the control variables chosen. We build on Dhaliwal et al. (2011). For instance, we control for sustainability performance (*SP*) as better-performing companies are more likely to voluntarily publish information about their performance (Dye, 1985). As each item of the Asset4 sustainability performance score is adjusted for relative industry performance, we recognize the across-industry differences of sustainability performance on the individual item level.[135] We refrain from using the KLD performance indicator as done by Dhaliwal et al. (2011) because it is a raw measurement that does not account for relative industry performance. Sustainability reporting is positively associated with company size (*SIZE*) (Deegan & Gordon, 1996; Marshall et al., 2001; Prado-Lorenzo et al., 2009) and profitability (*ROA*) (Dhaliwal et al., 2011; Marshall et al., 2001), which is why we control for these factors as well. As companies with low liquidity and high financing needs are more likely to improve their voluntary (sustainability) reporting quality (Clarkson et al., 2008; Dhaliwal et al., 2011; Frankel et al., 1995), we control for a company's share liquidity (*LIQUIDITY*) as well as for the net issuance of long-term debt and shares in a period (*FIN*). We also include earnings quality (*EM*) to control for a possible correlation between sustainability reporting and general disclosure policies as well as the financial transparency of a company (Dhaliwal et al., 2011).

Prior literature suggests that voluntary financial and non-financial disclosures are used as substitutes (Dhaliwal et al., 2014). We control for this substitutional relationship and include *MFCAST*, which indicates whether a firm has issued at least one management forecast in a year. As leverage affects debt holders' demand for disclosures and thereby increases agency costs (Jensen & Meckling, 1976), we control for leverage with *LEV*. We also control for market-to-book ratio (*MTB*) because prior literature has found a positive relationship between market-to-book ratio and sustainability disclosures (Prado-Lorenzo et al., 2009).

Firms with higher cost of equity are expected to improve their quality of sustainability reporting to lower their cost of equity (Dhaliwal et al., 2014). We estimate the cost of equity (*COEC)* for each company at the end of June of each year following the approach outlined in Hou et al. (2012) and take the mean value of five distinct cost of equity estimates, using both

[135] The sustainability performance score also consists of items that capture sustainability reporting, as the sustainability reporting score items are also included in the sustainability performance score. However, we believe that this overlap should not be an issue for two reasons. First, it affects only five out of 178 sustainability performance items. Second, even assuming that the overlap between both scores affects our results to a limited extent, it would only cause an upwards bias of the coefficients' standard errors due to multicollinearity (Brambor et al., 2006).

actual earnings numbers, as well as analyst forecasts (for a comprehensive explanation of the five different cost of equity measures, see El Ghoul et al. (2011) as well as Hou et al. (2012)). These are the Claus and Thomas (2001) model, the Gebhardt et al. (2001) model, the Gordon and Gordon (1997) model, the MPEG/ Easton (2004) model, as well as the Ohlson and Juetter-Nauroth (2005) model. Focusing on *ex-ante* implied cost of equity allows us to use a larger sample size, as we can rely more on cross-sectional variation across companies than on realized *ex-post* returns and explicit cost of equity (Chava, 2014). As globally operating companies may face stronger pressure to engage in (and report on) sustainability activities, we also integrate *GLOBAL* to indicate whether a firm reports foreign income (Dhaliwal et al., 2011). As an inverse measure for market competition, we integrate the Herfindahl-Hirschman index (*HHI)* (Dhaliwal et al., 2011). Additionally, to control for the impact of time-variant CEO characteristics in the decision-making process, we include the CEO's age (*CEOAGE)* and tenure (*CEOTEN),* as well as their prior experience as a CFO (*CFOEXP)* in the company they currently serve (Bochkay et al., 2019; Matsunaga &Yeung, 2008). Further, we add whether a company receives external assurance on its sustainability reporting (*EXTERNALSSURANCE)* and whether a company has signed the United Nations Global Compact (*GLOBALCOMPACT).* We include these two variables because the first appears to be at the intersection of sustainability performance and reporting (Steinmeier & Stich, 2019), and the second could be perceived as another indicator of sustainability performance (Cetindamar, 2007).

Further, we control for governance measures regarding the CEO and the board composition, as CEOs' power on a board might also influence the decision-making process. Hence, we include a proxy for CEO centricity (*CEO_POWER)* following Bauer et al. (2021), and (*CEO_DCHAIR),* a dummy for CEO duality (Song & Wan, 2019). Moreover, we add board characteristics such as the percentage of outside directors monitoring the CEO (*BOARD_INDEPENDENT)* (Jo & Harjoto, 2011), the sustainability expertise and voice by a chief sustainability officer (*CSO)* (Fu et al., 2020; Gallego-Álvarez & Pucheta-Martínez, 2020) and *BOARD_GENDER_DIV,* the female share on the board (Adams & Ferreira, 2009; Melero 2011). As compensation incentives might also influence executives in their decision making, we also add controls for (1) whether compensation is tied to a sustainability target (*BOARD_CSR_COMP)* (Tsang et al., 2021), and as investments in sustainability often pay off in the long term, (2) whether the compensation incentivizes management to reflect the longer-term performance of the company by utilizing the maximum time horizon in years for the director's targets to receive full compensation (*BOARD_LT_COMP)* (Mahoney & Thorne, 2005).

8.3 Further Analyses and Robustness Tests

8.3.1 CEO-Fixed Effects and Sustainability Reporting

Our main results suggest that the capital market sets a marginal increase in sustainability performance as a function of the individual CEOs with their high (low) fixed effects on sustainability reporting only for certain levels of sustainability reporting. Therefore, in this appendix, we further analyze how the level of sustainability reporting moderates sustainability performance on the next period's cost of equity relationship for high (low) CEO-fixed effects. First, building on our results for Hypothesis 2a, we specifically examine CEOs from the top tercile (i.e., CEOs that increase sustainability reporting relative to the baseline level of sustainability reporting) and how the relationship between sustainability performance and next-period cost of equity is moderated by a sustainability reporting level that is below the annual sample median. Our results suggest that for CEOs with a high CEO-fixed effect on sustainability reporting (relative to the company-specific baseline level), the capital market perceives this fixed effect as a negative signal in evaluating a marginal increase in sustainability performance given the sustainability reporting level is below the annual median (see Appendix 4 Figure IV-2). Alternatively, this could also be explained by the findings of Epstein and Schneider (2008). Their study suggests that potentially bad signals are responded to more strongly than positive signals when the underlying information quality is poor. In our case, if sustainability-related information still conveys ambiguous signals (i.e., if the level of reporting is not sufficient), increases in sustainability performance might be perceived as opportunistic and negatively related to firm value (Cahan et al., 2016).

Second, to complement our results with regard to Hypothesis 2b, we examine CEOs belonging to the bottom tercile (i.e., CEOs who reduce sustainability reporting relative to baseline levels of sustainability reporting) and how the relationship between sustainability performance and next period's cost of equity is moderated by a sustainability reporting level that is above the annual sample median. Complementing this, our results for the top tercile show that CEOs initiating a decline in sustainability reporting are interpreted as a positive signal when assessing a marginal increase in sustainability performance if a company has a disclosure level that is above the annual median. Our results suggest that an increase in sustainability performance is more likely to be interpreted as a positive signal when the CEO has a low CEO-fixed effect on sustainability reporting, as then the value of a marginal increase in sustainability reflects the true value or a positive outlook for the firm (Lys et al., 2015).

Our analysis related to low reporting levels may also suggest that investors sometimes have difficulties assessing the value of sustainability activities when the quality of reporting is insufficient and the resulting circumstances may be overly complex. Since there is an independent relationship between corporate complexity, information environment, and voluntary disclosures (Guay et al., 2016), we additionally test whether corporate complexity, in general, makes it difficult for investors to incorporate the additional information provided by CEO-fixed effects into their assessment of future risks. To this end, we split our sample by the median number of geographic (business) segments. Our results show a significant relationship between sustainability activities and their impact on next period's cost of equity, moderated by CEO-fixed effects and the level of reporting only for companies with low complexity (i.e., with number of geographic (business) segments below the sample median) (see Appendix 4 Figure IV-3). Regarding firms with a high complexity (i.e., firms with geographic (business) segments above the sample median) our results do not show any significant ranges (see Appendix 4 Figure IV-4). This is consistent with previous literature suggesting that information attributes such as complexity need to be taken into account when analyzing how information is processed by the capital market (e.g., in analyst forecasts) (Plumlee, 2003) and that investors do not fully respond to published information if it is considered too complex (You & Zhang, 2009).

8.3.2 CEO Style and Normative versus Legal Sustainability Activities

Prior literature distinguishes between sustainability activities that are legally required (legal) and those implemented on a voluntary basis (normative) (Harjoto & Jo, 2015). To better understand which specific elements are moderated by CEOs' sustainability reporting style, we follow prior research and distinguish between these two types using sustainability strengths and concerns data from KLD. We argue that relatively good performance in normative activities should drive reporting on it, motivated by the argument that companies need to disclose information about their strengths and activities. By contrast, relatively negative performance on legal sustainability activities (which tends to be composed of concerns)[136] leads to an increase in reporting, as companies feel the need to somehow take a stand. Thus, for our first model, we expect a positive (negative) relationship between normative (legal) sustainability activities and sustainability reporting. Regarding the results for our second model, we expect the overall relationship on signaling to be driven more by normative sustainability activities

[136] Interestingly, we find that legal sustainability activities relate primarily to concerns (20 concern vs. 2 strength items, whereas normative sustainability activities captures mostly strengths (41 strength vs. 17 concern items).

than by legal sustainability activities. We base this on our assumption that CEOs' style is mainly driven by their social values, and we, thus, expect that signaling is of primary importance when it comes to normative sustainability activities and the evaluation thereof.

To test our prediction, we follow Harjoto and Jo (2015) and replicate their measures of normative and legal sustainability activities (our sample, after including KLD sustainability strengths and concerns data, consists of 6,191 observations). We replace our Asset4 measure of sustainability performance with the normative (legal) sustainability performance measure and rerun our analysis for both normative and legal sustainability performance separately.[137] Regarding our first model, we obtain, as expected, a significant positive (0.140, p-val <0.05) (negative (-0.115, p-val <0.05)) coefficient for normative (legal) sustainability performance on sustainability reporting in the next period. In our second model, we only find a significant relationship between normative sustainability activities and next-period cost of equity moderated by sustainability reporting and a CEO-fixed effects (see Appendix 4 Figure IV-5), consistent with our reasoning that CEOs' sustainability reporting style is particularly important to investors when assessing normative sustainability activities. Then again, we fail to find a significant coefficient for legal sustainability performance, which we expected as well.

8.3.3 Robustness Tests

In this section, we conduct a battery of additional tests and analyses to verify and extend our main findings. First, we address the concern highlighted by Fee et al. (2013) concerning to the use of F-tests to test the significance of a large set of individual effects in the absence of very strong assumptions about the error term. Similar to them, we run a placebo test where we created artificial switches within the sample and assign each CEO-to-CEO mover who switches or leaves the sample to a different company within the sample. We repeat the random assignment 100 times and perform the first and second steps of the analysis using these synthetic samples. Concerning our first step, the two-sided Vuong test for a non-zero difference of the two models' explanatory power shows that the real-fixed effects significantly outperforms the placebo-fixed effects. Hereby, the average Z-statistic equals 6.04 (significant at the 1 percent level). In our second step of the analysis, we find no significant coefficient of the calibrated placebo terciles on the sustainability performance on the next period's future cost of equity

[137] Our mean values are consistent with those reported in their study (normative sustainability activities: 0.087 (our sample) vs. 0.098 (Harjoto and Jo, 2015) and legal sustainability activities: -0.064 vs. -0.150).

relationship, suggesting that the CEO-fixed effects identified in our main analysis indeed send a relevant signal to the capital market (see Appendix 4 Figure IV-6).

Then again, in the theoretical framework and in interpreting the results, we argue that CEOs' sustainability reporting styles shape the sustainability reporting of a company. An alternative explanation is that companies choose CEOs based on their style of sustainability reporting. Following this interpretation, managers do not shape a company through their specific style, but rather are chosen *because* of their specific style (Bertrand & Schoar, 2003). Companies strategically planning to increase their sustainability reporting quality may select a CEO who matches their preferences. However, since we are interested in the signal about the motives of corporate sustainability engagement that is conveyed by CEOs to investors and is based on publicly available information, it should make no difference to investors and their perception whether the signal reflects only the personal style of values or the underlying selection process as well. Contradicting this alternative interpretation, for the case of sustainability performance, Cronqvist and Yu (2017) find no strong evidence for an endogenous selection procedure of CEOs, suggesting it is indeed the CEO's impact that matters and that it is unlikely that CEOs are primarily hired for reasons linked to sustainability.

To test that it is CEO imprint rather than the CEO selection process that shapes the CEO-fixed effects in the case of sustainability reporting, we follow the argument by Kesner and Dalton (1994) that companies seeking a policy change are more likely to select a CEO from outside the company as internal candidates share the corporate identity and support the company's reporting practice to a larger degree. We, therefore, restrict the sample to those CEOs who were selected from an internal pool, i.e., who previously held another position within the same firm. We rerun Models (1a) and (1b) and again apply the firm cluster-robust Vuong test for equal (superior) model fit. We still find a significant explanatory power of CEOs in terms of across-firm differences in sustainability reporting, suggesting that it is the CEO-specific imprint rather than the CEO selection process that drives the CEO-fixed effects (see Appendix 4 Table 4). Additionally, we follow the approach of Fee et al. (2013) and distinguish between endogenous and exogenous CEO turnovers. We hand-collect the information on endogenous and exogenous turnover events as outlined by Fee et al. (2013). We then rerun our Models (1a) and (1b) on a restricted sample from which we exclude all CEOs that are likely to be endogenously selected, as in this case CEO-fixed effects are more likely shaped by the selection process. Similar to our test above, we still find significant explanatory power of CEOs for cross-firm differences in sustainability reporting suggesting our results are not mainly

driven by endogenous CEO selection (see Appendix 4 Table IV-5 and Appendix 4 Figure IV-7).

Next, we ensure that our results are robust to the construction of our sustainability reporting score. In our main analysis, all five items are equally weighted (e.g., 1/5). This weight is arbitrary to some extent as there is no obvious reason why the score items should not be weighted differently (e.g., stronger weighting of integrated management discussion and analysis (MD&A)). To ensure that our results are not sensitive to the construction of the score, we also assign the weights randomly. Hereby, we generate groups of five random numbers derived from uniformly distributed random variates over the interval 0 and 1 as item weights and repeat this procedure 100 times. As a result, we obtain 100 different versions of our sustainability reporting score and rerun our main analysis for each of these score versions. In all 100 runs, we find a higher explanatory power (significant at the 1 percent level) in explaining firm-level sustainability reporting quality for the model including CEO-fixed effects compared to the model without. The Vuong test Z-statistic varies from 9.89 to 12.51 with a mean of 12.51, a median of 12.57, and a standard deviation of 0.58. Looking at the results of our second model, we also find considerably stable results for the marginal relationship of sustainability reporting on cost of equity depending on CEO-fixed effects and sustainability performance. All mean values for our variables of interest as well as the overall model fit are qualitatively similar to our main regression results (see Appendix 4 Table IV-6).

Further, we apply an alternative definition of our sustainability reporting score and define *SR#* as the sum of all five indicator variables that comprise *SR* (i.e., *SR#* ranges from zero to five). The explanatory power of CEO fixed effects on the modified sustainability reporting score *SR#* is also comparable to the results with the primary sustainability reporting measure *SR* (see Appendix 4 Table IV-7). Hence, modifying the sustainability reporting score does not affect the previously identified importance of CEOs in explaining across-firm and over-time differences in the quality of sustainability reporting.

Additionally, we address the validity of our sustainability reporting score directly by comparing it with the sustainability reports themselves. Specifically, we hand-collect sustainability reports released by the companies in our sample[138] and perform a correlation analysis to validate our score versus the total length of the company's released report. We document a

[138] Due to the restricted availability, especially in the years before 2010, we were only able to identify 774 reports. For this reason we refrain from including these reports/related proxy into our main analysis.

significant positive correlation (0.36) between our sustainability reporting score (measuring both quality and scope) and the length of the sustainability report.

Finally, to ensure that the estimated fixed effects are associated with the individual reporting elements, we regress the CEO-fixed effects on the individual reporting elements in an additional test. For all five individual report elements, the coefficient on the CEO-fixed effects is significant and positive. For some of the elements, this effect is, in fact, larger: SRS1 (Separate Sustainability Report (Section)) (0.398, $p<0.01$), SRS4 (Stakeholder Engagement) (0.381, $p<0.01$), and SRS5 (Global Activities) (0.486, $p<0.01$). However, the effect is also positive for the other two elements SRS2 (GRI Reporting Guidelines) (0.145, $p<0.05$) and SRS3 (Integrated MD&A) (0.053, $p<0.05$), showing that CEO-fixed effects indeed influence each of the individual elements.

8.4 Result Tables and Figures of Additional Tests

Appendix 4 Table IV-1: CEO-fixed effects estimation with the AKM method

Dependent Variable: $SR_{i,t+1}$	(1)
$SP_{i,t}$	0.667***
	(0.029)
$SIZE_{i,t}$	0.024***
	(0.006)
$LIQUIDITY_{i,t}$	-0.002
	(0.002)
$FIN_{i,t}$	-0.025
	(0.016)
$ROA_{i,t}$	-0.053
	(0.038)
$HHI_{i,t}$	0.039
	(0.149)
$EM_{i,t}$	0.003
	(0.025)
$MFCAST_{i,t}$	0.000
	(0.010)
$LEV_{i,t}$	0.028
	(0.031)
$MTB_{i,t}$	-0.000
	(0.001)
$COEC_{i,t}$	0.052
	(0.081)
$GLOBAL_{i,t}$	0.017
	(0.013)
$CEOTEN_{i,k,t}$	0.019***
	(0.006)
$CEOAGE_{k,t}$	0.093
	(0.074)
$CFOEXP_{i,k}$	0.000
	(0.000)
$CLOBALCOMPACT_{i,t}$	0.017
	(0.013)
$EXTERNALASSURANCE_{i,t}$	0.039***
	(0.010)
$CEO\_POWER_{i,k,t}$	0.067*
	(0.039)
$CSO_{i,t}$	0.014
	(0.014)
$CEO\_DCHAIR_{i,t}$	0.012
	(0.010)
$BOARD\_CSR\_COMP_{i,t}$	-0.026***
	(0.008)
$BOARD\_LT\_COMP_{i,t}$	-0.007***

Cont. Appendix 4 Table IV-1

	(0.002)
$BOARD\_GENDER\_DIV_{i,t}$	-0.001**
	(0.000)
$BOARD\_INDEPENDENT_{i,t}$	-0.000
	(0.000)
Observations	7,149
R-squared within	0.3944
Firm FE	YES
Time FE	YES
CEO FE	YES

F-test that CEO and firm effects are equal to zero:	F (1764, 5818) = 7.27***
F-test that CEO effects are equal to zero:	F (1747, 5818) = 7.09***
F-test that firm effects are equal to zero:	F (17, 5818) = 13.02***

This table presents the regression results for Model (1b) using the AKM method. All variables are as defined in Table 3. Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Appendix 4 Table IV-2: Sustainability reporting and CEO turnovers

Dependent Variable: $SR_{i,t+1}$	(1)	(2)	(3)
$CEOTURNO1_{i,t}$	0.000		
	(0.011)		
$CEOTURNO2_{i,t}$		-0.001	
		(0.006)	
$CEOTURNO3_{i,t}$			-0.001
			(0.005)
$SP_{i,t}$	0.791***	0.791***	0.791***
	(0.045)	(0.045)	(0.045)
$SIZE_{i,t}$	0.031***	0.031***	0.031***
	(0.009)	(0.009)	(0.009)
$LIQUIDITY_{i,t}$	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.004)
$FIN_{i,t}$	-0.016	-0.016	-0.016
	(0.018)	(0.018)	(0.018)
$ROA_{i,t}$	-0.091*	-0.091*	-0.091*
	(0.049)	(0.049)	(0.049)
$HHI_{i,t}$	0.076	0.076	0.076
	(0.263)	(0.264)	(0.264)
$EM_{i,t}$	-0.013	-0.013	-0.013
	(0.023)	(0.023)	(0.023)
$MFCAST_{i,t}$	-0.009	-0.009	-0.009
	(0.017)	(0.017)	(0.017)
$LEV_{i,t}$	0.024	0.024	0.024
	(0.050)	(0.050)	(0.049)
$MTB_{i,t}$	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
$COEC_{i,t}$	0.164	0.164	0.164
	(0.103)	(0.103)	(0.103)
$GLOBAL_{i,t}$	0.005	0.005	0.005
	(0.008)	(0.005)	(0.005)
$CEOTEN_{i,k,t}$	-0.087	-0.087	-0.087
	(0.054)	(0.053)	(0.053)
$CEOAGE_{k,t}$	0.011	0.011	0.011
	(0.019)	(0.019)	(0.019)
$CFOEXP_{i,k}$	-0.006	-0.006	-0.006
	(0.019)	(0.019)	(0.019)
$CLOBALCOMPACT_{i,t}$	0.011	0.011	0.011
	(0.024)	(0.024)	(0.024)
$EXTERNALASSURANCE_{i,t}$	0.051***	0.051***	0.051***
	(0.016)	(0.016)	(0.016)
$CEO\_POWER_{i,k,t}$	0.027	0.027	0.027
	(0.046)	(0.046)	(0.045)
$CSO_{i,t}$	0.048***	0.048***	0.048***
	(0.018)	(0.018)	(0.018)
$CEO\_DCHAIR_{i,t}$	0.007	0.007	0.007
	(0.014)	(0.014)	(0.014)
$BOARD\_CSR\_COMP_{i,t}$	-0.027*	-0.027*	-0.027*
	(0.014)	(0.014)	(0.014)
$BOARD\_LT\_COMP_{i,t}$	-0.008**	-0.008**	-0.008**
	(0.003)	(0.003)	(0.003)
$BOARD\_GENDER\_DIV_{i,t}$	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
$BOARD\_INDEPENDENT_{i,t}$	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
CONSTANT	-0.147	-0.147	-0.147

Cont. Appendix 4 Table IV-2

	(0.221)	(0.218)	(0.218)
Observations	7,149	7,149	7,149
Adjusted R-squared	0.493	0.493	0.493
Firm FE	YES	YES	YES
Time FE	YES	YES	YES

This table presents the regression results for Model (1a) plus indicator variables for CEO turnovers. Column 1 presents the results for *CEOTURNO1*, an indicator variable that equals 1 if a new CEO has been appointed in the current period. Column 2 with *CEOTURNO2* includes CEO turnovers in the last period and column 3 with *CEOTURNO3* includes CEO turnovers in the second-to-last period. All other variables are as defined in Table 3. Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Appendix 4 Table IV-3: Sustainability reporting and CEO turnovers with interaction term

Dependent Variable: $SR_{i,t+1}$	(1)	(2)	(3)
$CEOTURNO1_{i,t}$	-0.005		
	(0.015)		
$CEOTURNO1_{i,t} * SP_{i,t}$	0.014		
	(0.027)		
$CEOTURNO2_{i,t}$		0.008	
		(0.013)	
$CEOTURNO2_{i,t} * SP_{i,t}$		-0.021	
		(0.027)	
$CEOTURNO3_{i,t}$			0.004
			(0.011)
$CEOTURNO3_{i,t} * SP_{i,t}$			-0.010
			(0.023)
$SP_{i,t}$	0.790***	0.794***	0.793***
	(0.044)	(0.045)	(0.045)
$SIZE_{i,t}$	0.031***	0.031***	0.031***
	(0.009)	(0.009)	(0.009)
$LIQUIDITY_{i,t}$	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.004)
$FIN_{i,t}$	-0.016	-0.016	-0.016
	(0.018)	(0.018)	(0.018)
$ROA_{i,t}$	-0.091*	-0.091*	-0.091*
	(0.049)	(0.049)	(0.049)
$HHI_{i,t}$	0.075	0.076	0.076
	(0.263)	(0.264)	(0.264)
$EM_{i,t}$	-0.013	-0.013	-0.013
	(0.023)	(0.023)	(0.023)
$MFCAST_{i,t}$	-0.009	-0.008	-0.008
	(0.017)	(0.017)	(0.017)
$LEV_{i,t}$	0.024	0.024	0.024
	(0.050)	(0.050)	(0.050)
$MTB_{i,t}$	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
$COEC_{i,t}$	0.165	0.163	0.164
	(0.102)	(0.102)	(0.102)
$GLOBAL_{i,t}$	0.005	0.005	0.005
	(0.008)	(0.005)	(0.005)
$CEOTEN_{i,k,t}$	-0.087	-0.087	-0.087
	(0.054)	(0.053)	(0.053)
$CEOAGE_{k,t}$	0.011	0.011	0.011
	(0.019)	(0.019)	(0.019)
$CFOEXP_{i,k}$	-0.006	-0.006	-0.006
	(0.019)	(0.019)	(0.019)
$CLOBALCOMPACT_{i,t}$	0.011	0.011	0.011
	(0.024)	(0.024)	(0.024)
$EXTERNALASSURANCE_{i,t}$	0.051***	0.051***	0.051***
	(0.016)	(0.016)	(0.016)
$CEO\_POWER_{i,k,t}$	0.027	0.026	0.027
	(0.046)	(0.046)	(0.046)
$CSO_{i,t}$	0.048***	0.048***	0.048***
	(0.018)	(0.018)	(0.018)
$CEO\_DCHAIR_{i,t}$	0.007	0.007	0.007
	(0.014)	(0.014)	(0.014)
$BOARD\_CSR\_COMP_{i,t}$	-0.027*	-0.027*	-0.027*
	(0.014)	(0.014)	(0.014)
$BOARD\_LT\_COMP_{i,t}$	-0.008**	-0.008**	-0.008**

Cont. Appendix 4 Table IV-3

	(0.003)	(0.003)	(0.003)
$BOARD\_GENDER\_DIV_{i,t}$	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
$BOARD\_INDEPENDENT_{i,t}$	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
CONSTANT	-0.148	-0.148	-0.147
	(0.221)	(0.218)	(0.218)
Observations	7,149	7,149	7,149
Adjusted R-squared	0.493	0.493	0.493
Firm FE	YES	YES	YES
Time FE	YES	YES	YES

This table presents the regression results for Model (1a) plus indicator variables for CEO turnovers. Beside the main effect of *CEOTURNO* already included in the regressions displayed in Appendix 4 Table 2, all three regressions in this table interact *CEOTURNO* also with the current period's sustainability performance *SP* to control for potential interaction effects. Column 1 presents the results for *CEOTURNO1*, an indicator variable that equals 1 if a new CEO has been appointed in the current period. Column 2 with *CEOTURNO2* includes CEO turnovers in the last period and Column 3 with *CEOTURNO3* includes CEO turnover in the second-to-last period. All other variables are as defined in Table 3. Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Appendix 4 Table IV-4: CEO-fixed effects estimation using only CEOs from the internal pool

Dependent Variable: $SR_{i,t+1}$	(1)	(2)
Panel A: Regression results		
VARIABLES		
$SP_{i,t}$	0.816***	0.671***
	(0.053)	(0.060)
$SIZE_{i,t}$	0.031***	0.015
	(0.011)	(0.012)
$LIQUIDITY_{i,t}$	-0.003	-0.003
	(0.004)	(0.005)
$FIN_{i,t}$	-0.018	-0.038
	(0.023)	(0.024)
$ROA_{i,t}$	-0.120*	-0.029
	(0.062)	(0.060)
$HHI_{i,t}$	0.089	-0.090
	(0.298)	(0.355)
$EM_{i,t}$	-0.003	0.017
	(0.029)	(0.029)
$MFCAST_{i,t}$	-0.027	-0.028*
	(0.023)	(0.017)
$LEV_{i,t}$	0.015	0.006
	(0.062)	(0.063)
$MTB_{i,t}$	0.001	0.001
	(0.001)	(0.001)
$COEC_{i,t}$	0.137	0.059
	(0.120)	(0.113)
$GLOBAL_{i,t}$	0.004	0.016
	(0.007)	(0.014)
$CEOTEN_{ik..t}$	-0.094	0.083
	(0.072)	(0.127)
$CEOAGE_{k.t}$	0.013	0.026
	(0.021)	(0.021)
$CFOEXP_{i.k}$	-0.004	0.079***
	(0.023)	(0.027)
$CLOBALCOMPACT_{it.}$	0.013	0.008
	(0.027)	(0.034)
$EXTERNALASSURANCE_{i.t}$	0.035*	0.022
	(0.018)	(0.018)
$CEO\_POWER_{i,k,t}$	-0.007	0.086
	(0.060)	(0.064)
$CSO_{i,t}$	0.036**	0.014
	(0.016)	(0.019)
$CEO\_DCHAIR_{i,t}$	0.009	0.023
	(0.017)	(0.020)
$BOARD\_CSR\_COMP_{i,t}$	-0.024	-0.028
	(0.017)	(0.018)
$BOARD\_LT\_COMP_{i,t}$	-0.007	-0.008*
	(0.004)	(0.004)
$BOARD\_GENDER\_DIV_{i,t}$	-0.000	-0.001
	(0.001)	(0.001)
$BOARD\_INDEPENDENT_{i,t}$	-0.000	-0.001
	(0.001)	(0.001)
CONSTANT	-0.089	-0.648
	(0.304)	(0.485)
Observations	5,251	5,251
Adjusted R-squared	0.494	0.611
Firm FE	YES	YES
Time FE	YES	YES
CEO FE	NO	YES

Cont. Appendix 4 Table IV-4

Panel B: Cluster-robust Vuong test	
Vuong Z-Statistic:	10.917***
p-Value:	0.000 (***)

Panel A presents the regression results for Model (1a) without CEO-fixed effects (Column 1) and Model (1b) with CEO-fixed effects (Column 2). The sample includes all CEOs from the internal pool. All variables are as defined in Table 3. Panel B shows the test statistics for the Vuong test using firm-clustered standard errors with H0: Model (1a) and Model (1b) are equally close to the true specification and H1: Model (1b) is closer to the true specification than Model (1a). Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Appendix 4 Table IV-5: CEO-fixed effects estimation excluding CEOs from identified endogenous turnover events

Dependent Variable: $SR_{i,t+1}$	(1)	(2)
Panel A: Regression results		
VARIABLES		
$SP_{i,t}$	0.798***	0.671***
	(0.046)	(0.052)
$SIZE_{i,t}$	0.034***	0.024**
	(0.009)	(0.010)
$LIQUIDITY_{i,t}$	-0.002	-0.003
	(0.004)	(0.004)
$FIN_{i,t}$	-0.010	-0.021
	(0.018)	(0.019)
$ROA_{i,t}$	-0.098*	-0.066
	(0.050)	(0.049)
$HHI_{i,t}$	0.164	0.032
	(0.263)	(0.326)
$EM_{i,t}$	-0.014	0.002
	(0.024)	(0.024)
$MFCAST_{i,t}$	-0.008	0.003
	(0.017)	(0.016)
$LEV_{i,t}$	0.038	0.025
	(0.049)	(0.048)
$MTB_{i,t}$	-0.000	-0.000
	(0.001)	(0.001)
$COEC_{i,t}$	0.179*	0.067
	(0.106)	(0.099)
$GLOBAL_{i,t}$	0.003	0.019*
	(0.005)	(0.011)
$CEOTEN_{i,k,t}$	-0.061	0.122
	(0.054)	(0.098)
$CEOAGE_{k.t}$	0.017	0.016
	(0.020)	(0.018)
$CFOEXP_{i,k}$	-0.007	-0.003
	(0.020)	(0.032)
$CLOBALCOMPACT_{i.t.}$	0.008	0.008
	(0.025)	(0.029)
$EXTERNALASSURANCE_{i.t}$	0.049***	0.038**
	(0.016)	(0.017)
$CEO\_POWER_{i,k,t}$	0.007	0.032
	(0.045)	(0.050)
$CSO_{i,t}$	0.050***	0.015
	(0.019)	(0.019)
$CEO\_DCHAIR_{i,t}$	0.010	0.021
	(0.014)	(0.018)
$BOARD\_CSR\_COMP_{i,t}$	-0.030**	-0.032**
	(0.014)	(0.015)
$BOARD\_LT\_COMP_{i,t}$	-0.009***	-0.008**
	(0.003)	(0.004)
$BOARD\_GENDER\_DIV_{i,t}$	-0.001	-0.001*
	(0.001)	(0.001)
$BOARD\_INDEPENDENT_{i,t}$	-0.000	-0.000
	(0.000)	(0.000)
CONSTANT	-0.286	-0.856**
	(0.220)	(0.385)
Observations	6,925	6,925
Adjusted R-squared	0.493	0.617
Firm FE	YES	YES
Time FE	YES	YES

Cont. Appendix 4 Table IV-5

CEO FE		NO	YES
Panel B: Cluster-robust Vuong test			
Vuong Z-Statistic:	12.273***		
p-Value:	0.000 (***)		

Panel A presents the regression results for Model (1a) without CEO fixed effects (Column 1) and Model (1b) with CEO fixed effects (Column 2). The sample excludes all CEOs appointed after an identified endogenous turnover event. All variables are as defined in Table 3. Panel B shows the test statistics for the Vuong test using firm-clustered standard errors with H0: Model (1a) and Model (1b) are equally close to the true specification and H1: Model (1b) is closer to the true specification than Model (1a). Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below.

Appendix 4 Table IV-6: Cost of equity and CEO-fixed effects – Random score weighting

Dependent Variable: $COEC_{i,t+1}$	(1)	(2)
VARIABLES	(Mean) Coefficient	T-value
$CEOFE_{i,t}$	0.000	0.264
$SR_{i,t}$	0.058***	68.500
$SP_{i,t}$	0.003**	3.020
$CEOFE_{i,t} * SR_{i,t}$	-0.019***	-50.330
$CEOFE_{i,t} * SP_{i,t}$	0.004***	8.565
$SP_{i,t} * SR_{i,t}$	-0.087***	-56.534
$CEOFE_{i,t} *SR_{i,t}* SP_{i,t}$	0.027***	36.845
Obervations (in each regression)	7,149	
(Mean) R-squared	0.625	
Number of Regressions	100	
Firm FE	YES	
Time FE	YES	
Controls	YES	

This table reports average coefficients estimated with 100 different weights for the composition of SR for Model (2). Column 1 presents the mean effects of CEO-fixed effects on next period's cost of equity. All variables are as defined in Table 3. Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. The t-statistic reported is equal to the average coefficient divided by its standard error.

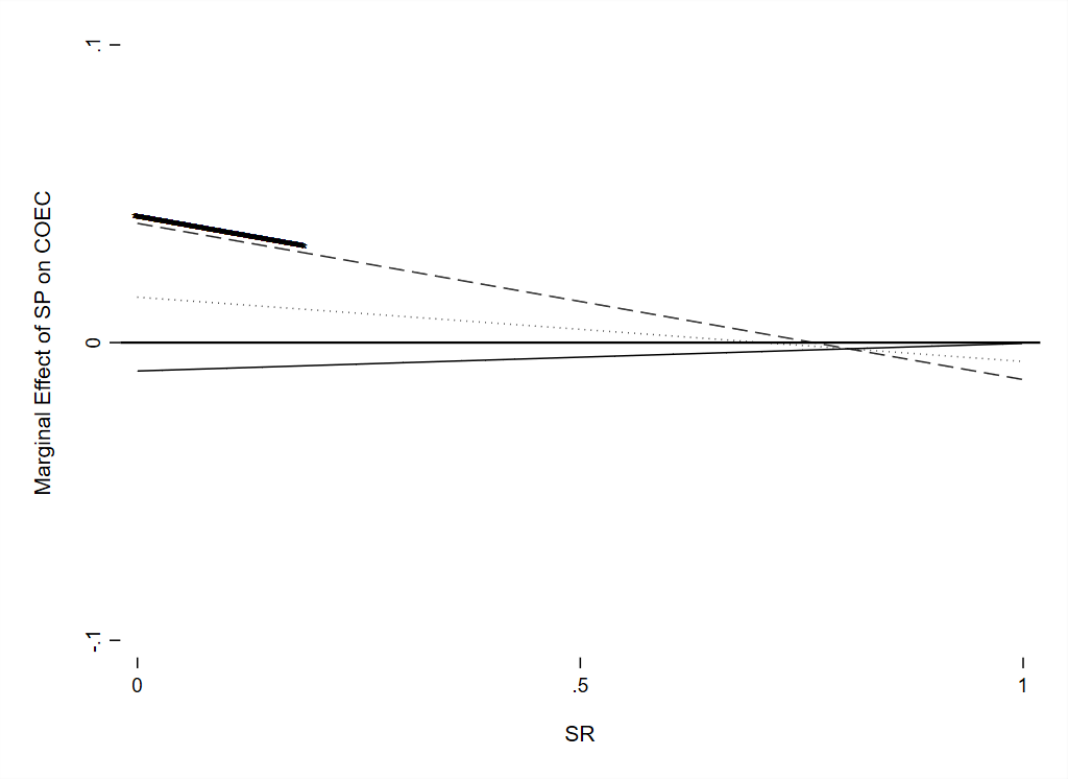
Appendix 4 Table IV-7: CEO-fixed effects estimation using SR#

Dependent Variable: $SR\#_{i,t+1}$	(1)	(2)
Panel A: Regression results		
VARIABLES		
$SP_{i,t}$	3.648***	3.064***
	(0.214)	(0.244)
$SIZE_{i,t}$	0.148***	0.135***
	(0.041)	(0.045)
$LIQUIDITY_{i,t}$	-0.006	-0.008
	(0.018)	(0.019)
$FIN_{i,t}$	-0.048	-0.078
	(0.085)	(0.088)
$ROA_{i,t}$	-0.425*	-0.234
	(0.228)	(0.234)
$HHI_{i,t}$	-0.177	0.131
	(1.188)	(1.449)
$EM_{i,t}$	-0.031	0.023
	(0.110)	(0.110)
$MFCAST_{i,t}$	0.019	0.063
	(0.073)	(0.066)
$LEV_{i,t}$	0.179	0.117
	(0.232)	(0.228)
$MTB_{i,t}$	-0.002	-0.002
	(0.003)	(0.004)
$COEC_{i,t}$	0.749	0.166
	(0.489)	(0.466)
$GLOBAL_{i,t}$	0.026	0.069
	(0.024)	(0.051)
$CEOTEN_{i,k,t}$	-0.346	0.314
	(0.243)	(0.416)
$CEOAGE_{k,t}$	0.021	0.035
	(0.087)	(0.079)
$CFOEXP_{i,k}$	-0.047	0.059
	(0.095)	(0.142)
$CLOBALCOMPACT_{i,t}$	0.121	0.140
	(0.119)	(0.141)
$EXTERNALASSURANCE_{i,t}$	0.396***	0.314***
	(0.075)	(0.085)
$CEO\_POWER_{i,k,t}$	0.051	0.263
	(0.211)	(0.239)
$CSO_{i,t}$	0.271***	0.108
	(0.093)	(0.089)
$CEO\_DCHAIR_{i,t}$	0.024	0.058
	(0.065)	(0.085)
$BOARD\_CSR\_COMP_{i,t}$	-0.103	-0.082
	(0.069)	(0.073)
$BOARD\_LT\_COMP_{i,t}$	-0.031**	-0.015
	(0.016)	(0.018)
$BOARD\_GENDER\_DIV_{i,t}$	-0.003	-0.004
	(0.003)	(0.003)
$BOARD\_INDEPENDENT_{i,t}$	-0.003	-0.003
	(0.002)	(0.002)
CONSTANT	-0.906	-3.320**
	(0.985)	(1.636)
Observations	7,149	7,149
Adjusted R-squared	0.487	0.608

Cont. Appendix 4 Table IV-7		
Firm FE	YES	YES
Time FE	YES	YES
CEO FE	NO	YES
Panel B: Cluster-robust Vuong test		
Vuong Z-Statistic:	12.952	
p-Value:	0.000 (***)	

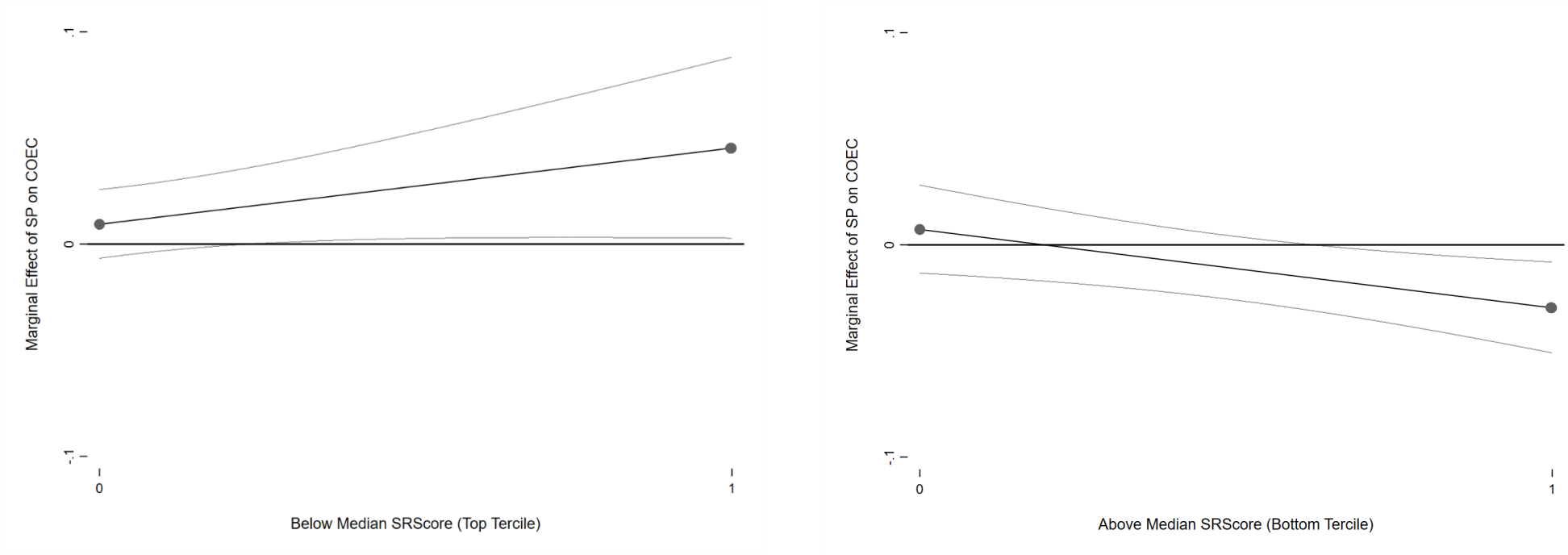
Panel A presents the regression results for Model (1a) without CEO-fixed effects (Column 1) and Model (1b) with CEO-fixed effects (Column 2). All variables are as defined in Table 3. Panel B shows the test statistics for the Vuong test using firm-clustered standard errors with H0: Model (1a) and Model (1b) are equally close to the true specification and H1: Model (1b) is closer to the true specification than Model (1a). Asterisks indicate significance levels with: *** p<0.01, ** p<0.05, and * p<0.1. Standard errors are reported in parentheses below. *SR#* is defined as the sum of all five indicator variables that comprise *SR.*

Appendix 4 Figure IV-1: Marginal effect of *SP* on *COEC* depending on *SR* and CFO-fixed effects



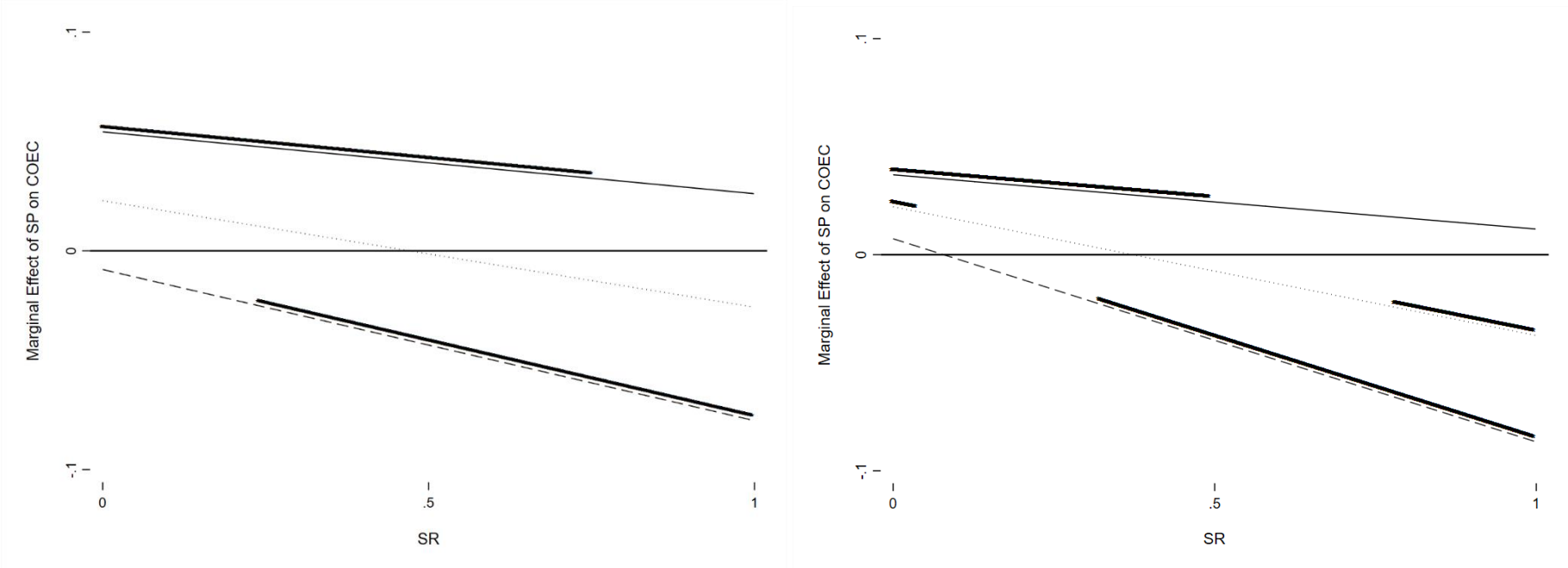
This figure shows the marginal effect of sustainability performance (*SP*) on the next period's cost of equity (*COEC*) depending on CFO-fixed effects (*CFOFE*) and sustainability reporting (*SR*). The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on the next period's equity depending on sustainability reporting levels for firms with a CFO from the bottom (middle, top) CFO-fixed effect tercile. Values of sustainability reporting levels and CFO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on the next period's cost of equity at the 10 percent significance level are indicated with a bold line above the respective variables' value combinations.

Appendix 4 Figure IV-2: Marginal effect of *SP* on *COEC* depending on *SR Reporting Levels* (above and below annual median) and CEO-fixed effects



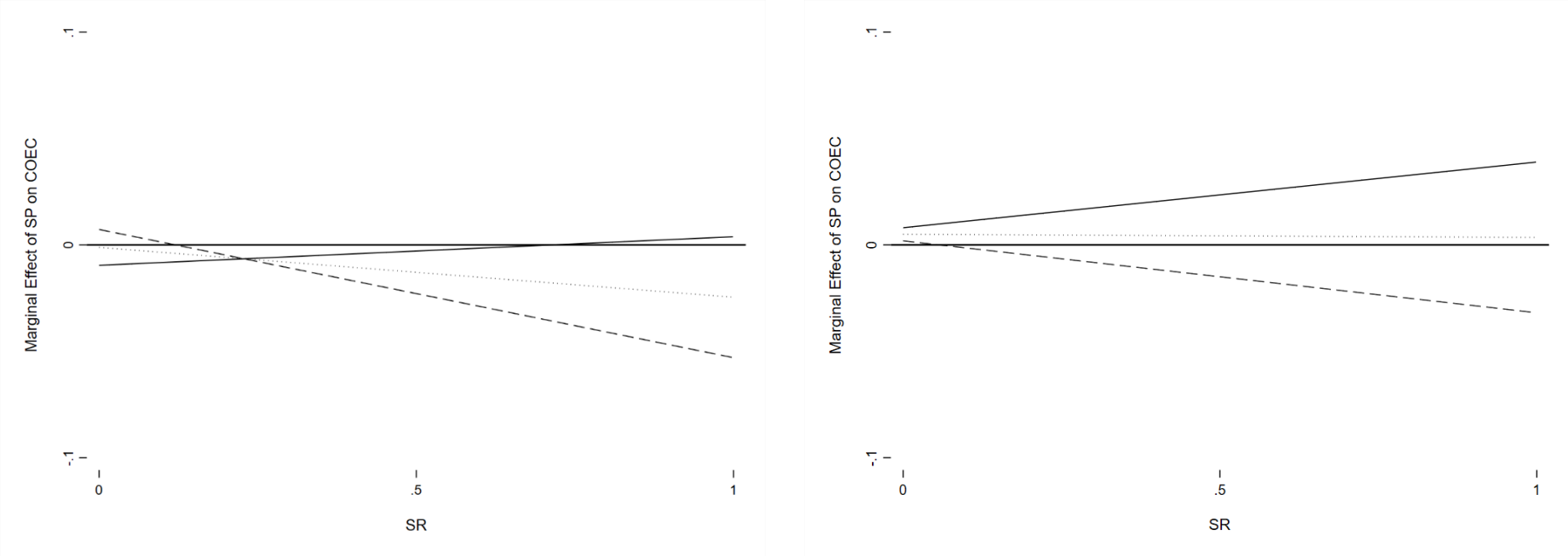
This figure shows the marginal effect of sustainability performance (*SP*) on next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) as well as the level of sustainability reporting (*SR*). The left graph shows the relationship between *SP* on next period's *CEOC* for the CEOs assigned to the top tercile depending on whether a company has a sustainability reporting level below the median reporting level in the current year. The right graph shows the relationship between *SP* on next period's *CEOC* for the CEOs assigned to the bottom tercile depending on whether a company has a SR reporting level above the median reporting level in the current year. Significant marginal effect of sustainability performance on next period's cost of equity at the 10 percent significance level are indicated by the confidence intervals shown by the grey lines.

Appendix 4 Figure IV-3: Marginal effect of *SP* on *COEC* depending on *SR* and CEO-fixed effects –Non complex companies



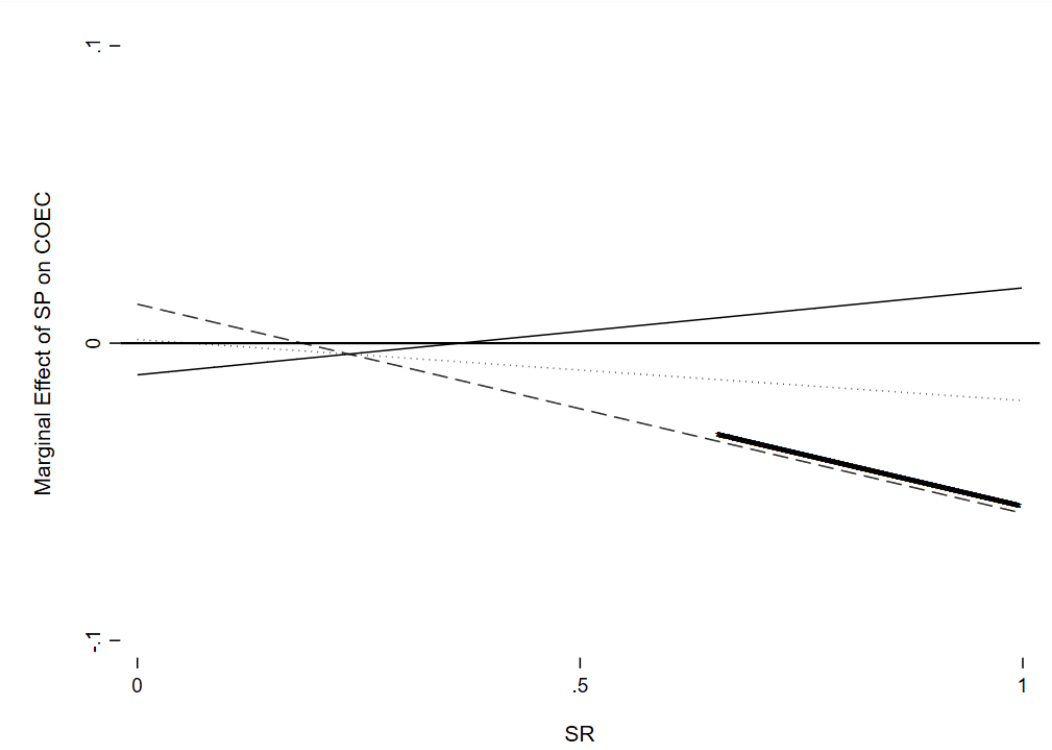
This figure shows the marginal effect of sustainability performance (*SP*) on next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) as well as sustainability reporting (*SR*). The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on next period's equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on next period's cost of equity at the 10 percent significance level are indicated with a bold line positioned above the respective variables' value combinations. The graph left (right) includes only firms with a number in geographical (business) segments below the sample median.

Appendix 4 Figure IV-4: Marginal effect of *SP* on *COEC* depending on *SR* and CEO-fixed effects – Complex companies



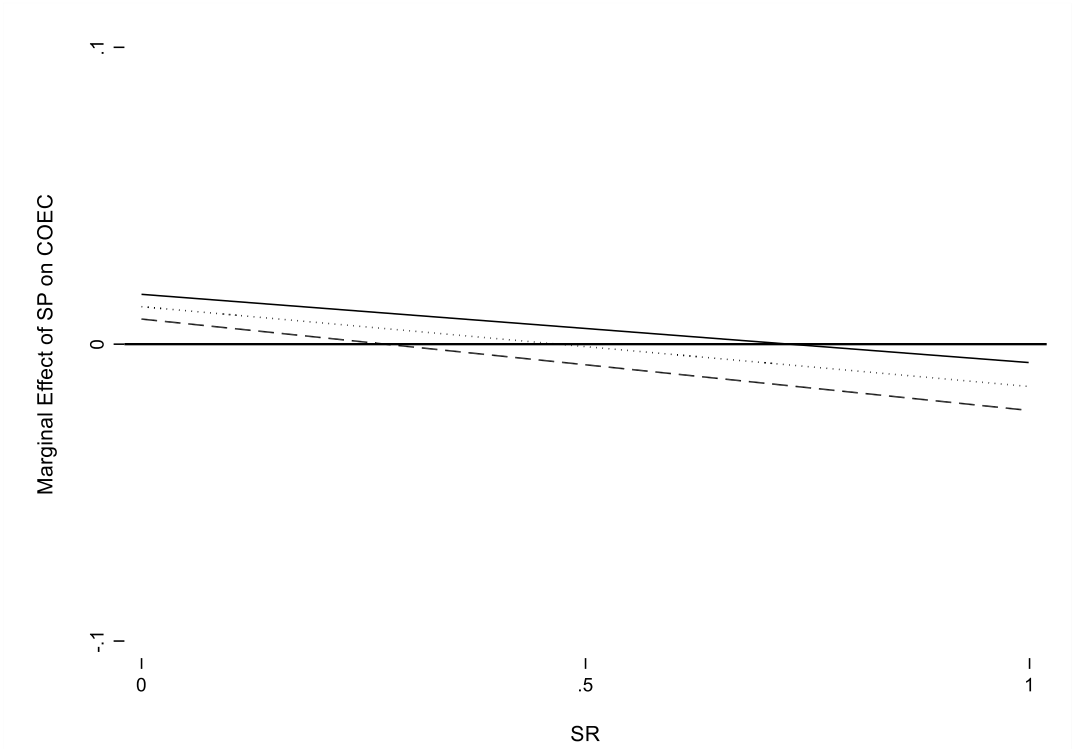
This figure shows the marginal effect of sustainability performance (*SP*) on next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) as well as sustainability reporting (*SR*). The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on next period's equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on next period's cost of equity at the 10 percent significance level are indicated with a bold line positioned above the respective variables' value combinations. The graph left (right) includes only firms with a number in geographic (business) segments above the sample median.

Appendix 4 Figure IV-5: Marginal effect of *SP* on *COEC* depending on *SR* and CEO-fixed effects – Normative CSR



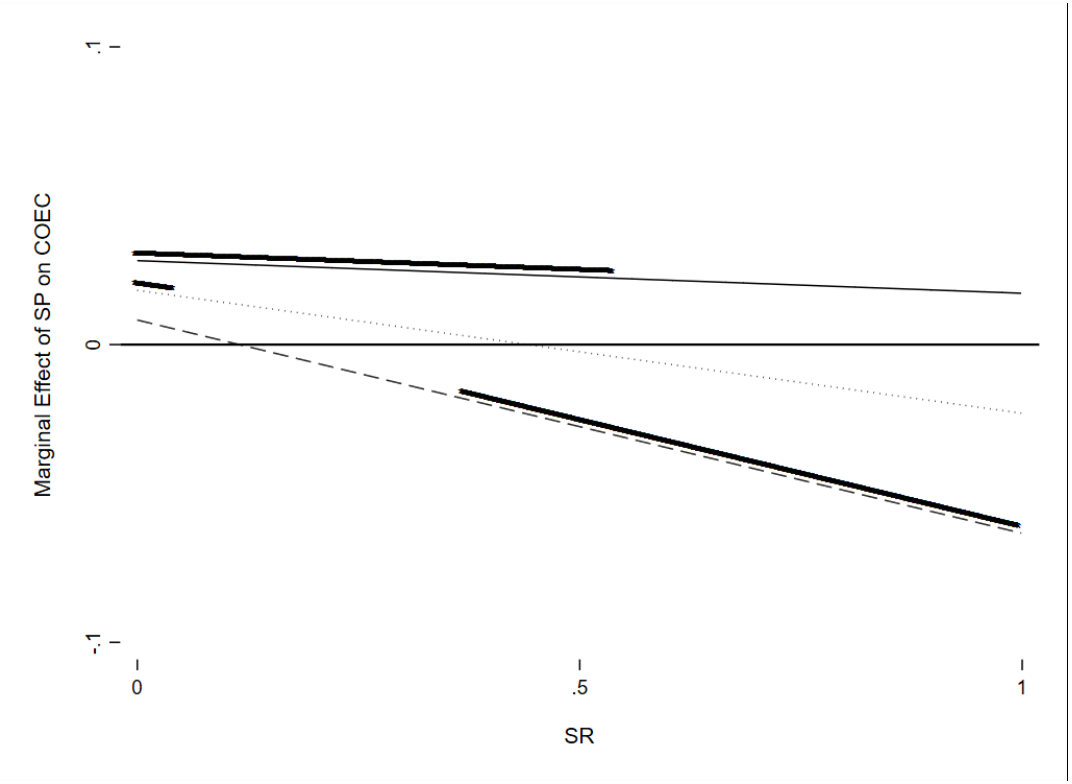
This figure shows the marginal effect of sustainability performance (*SP*), in this case normative sustainability activities according to Harjoto and Jo (2015), on the next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) and sustainability reporting (*SR*). The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on the next period's equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on the next period's cost of equity at the 10 percent significance level are indicated with a bold line above the respective variables' value combinations.

Appendix 4 Figure IV-6: Marginal effect of *SP* on *COEC* depending on *SR* and CEO-fixed effects – Synthesized CEO within sample switches



This figure shows the average marginal effect of sustainability performance (*SP*), on the next period's cost of equity (*COEC*) depending on synthesized CEO-fixed effects (*CEOFE*) and sustainability reporting (*SR*). CEOFE are estimated on a sample with synthesized CEO within sample switches. The random allocation was performed 100 times, the effect displayed are the mean effects from each random estimation. The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on the next period's equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find an on average significant marginal effect of sustainability performance on the next period's cost of equity at the 10 percent significance level are indicated with a bold line above the respective variables' value combinations.

Appendix 4 Figure IV-7: Marginal effect of *SP* on *COEC* depending on *SR* and CEO-fixed effects – Excluding CEOs from identified endogenous turnover events



This figure shows the marginal effect of sustainability performance (*SP*), on the next period's cost of equity (*COEC*) depending on CEO-fixed effects (*CEOFE*) and sustainability reporting (*SR*). *CEOFE* are estimated on a sample excluding all CEOs appointed after an identified endogenous turnover event. The dashed (dotted, full) lines indicate the marginal effect of sustainability performance on the next period's equity depending on sustainability reporting levels for firms with a CEO from the bottom (middle, top) CEO-fixed effect tercile. Values of sustainability reporting levels and CEO-fixed effect terciles for which we find a significant marginal effect of sustainability performance on the next period's cost of equity at the 10 percent significance level are indicated with a bold line above the respective variables' value combinations.

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Part V: Evolution, Motives, and Perception of Biodiversity-Related Disclosure: The Application of GRI 304

Anna Rafaela Rudolf

1. Introduction

Biodiversity, i.e. biological diversity, refers to *"the variability among living organisms from all sources [. . .] and the ecological complexes of which they are part"* (UN, 1992). With an extinction rate at unprecedented levels (Pimm et al., 2014) and half of global gross domestic product (GDP) dependent on intact biodiversity and functioning ecosystems (WEF, 2020b), biodiversity loss is considered a top five global risk (WEF, 2020a, 2021). Demonstrating the immense impact and dependence of the economy on biodiversity, the overall human alteration of ecosystems creates several risks for businesses (Dasgupta, 2021). Since 2010, the United Nations' (UN) *International Year of Biodiversity* and the subsequent announcement of the *Decade on Biodiversity* for the years 2011 to 2020, various frameworks and programs, such as the economics of the ecosystem (UNEP, 2010), have been established. However, with the Decade now over, it remains unclear to what extent businesses and investors are aware of biodiversity and environmental degradation, given the focus of recent studies on the risks associated with climate change (Hong et al., 2020).

Adler et al. (2017) show that mining companies increased their biodiversity-related disclosure (BRD) around the UN's announcement of the *Decade on Biodiversity* in 2010. However, according to several other studies that cover only snapshots in time, company attention to biodiversity and BRD remains limited (e.g., Adler et al., 2018; Moussa et al., 2021). Previous research on the determinants of whether and to what extent companies engage in BRD has mostly relied on qualitative analysis and a small number of environmental, social, and governance (ESG) disclosures with a focus on specific countries or sectors (Bhattacharyya & Yang, 2019; Rimmel & Jonäll, 2013; Skouloudis et al., 2019). Moreover, the high complexity of quantifying the benefits and risks of biodiversity (Schaltegger et al., 2022) is widely acknowledged by researchers and policymakers. Accordingly, we sought to examine whether there has been an overall increase in awareness of and sensitivity to biodiversity-related challenges (both internal and external) and the disclosure thereof over the past decade.

Building on assumptions of stakeholder and legitimacy theory (Adler et al., 2018), one would expect companies to deliver higher BRD quality as required by the reporting standards of the Global Reporting Initiative (GRI) once they become aware of their impacts and dependencies on intact biodiversity and ecosystems. In this context, the GRI framework comprises the most frequently applied disclosure standards; in fact, for a long time it was the only framework that made explicit reference to biodiversity (Maroun & Atkins, 2021). Drawing on prior studies with similar approaches, we evaluate the quality of BRD according to the items required by the GRI standards (Michelon et al., 2015), analyzing 2,843 reports published from 2010 to 2019

across 43 countries according to the GRI 304 standard on biodiversity. In addition, we collect the quantitative measures in the reports as required by GRI 304.

Over the entire period we observe neither an increase in the adoption of GRI 304 (or its items) nor an increase in BRD quality over time. Consequently, a) companies themselves do not perceive biodiversity as an important stakeholder issue, and b) they are not under sufficient stakeholder pressure to engage in BRD. In addition, our results indicate an inconsistent application of GRI 304 and a low level of comparability between the different BRDs. In an attempt to explain the differences in the level of BRD quality, we examine whether awareness of the risks associated with climate change (one of the main drivers of biodiversity loss) increases the quality of BRD. We empirically show that companies report higher-quality BRD in years in which they also respond to the Carbon Disclosure Project's (CDP) questionnaire. Furthermore, we show that companies that self-report exposure to material climate risks indeed do provide higher-quality BRD. Surprisingly, we find that the quality of BRD decreases when executive compensation is linked to climate-related actions.

The interplay between climate change and perceived financial risk (e.g., Painter, 2020), or climate change-related risk reporting and financial risk (e.g., Matsumura et al., 2022) is already established in the literature. However, no study has yet analyzed the effect of BRD on perceived risk factors. To capture investors' risk perception, we follow prior studies and capture investors' risk perceptions via implied cost of equity capital (COEC) (e.g., Dhaliwal et al., 2016). In further regression analysis, we find that companies with higher BRD quality are perceived as exposed to higher financial risk.

In additional analyses, we evaluate overall stakeholder response by capturing a firm's reputation with the sentiment in news articles related to social or environmental events associated with that firm. Our results indicate that stakeholder value high-quality BRD according to GRI 304. Further, in subsequent analyses, we show that even if companies do not consistently apply GRI 304, high-quality BRD according to the items in GRI 304 is associated with fewer framing techniques related to impression management (i.e., less usage of positive, forward-looking, and uncertain phrases).

Our results contribute to the literature in four ways. First, this study provides evidence of insights into the quality and quantity of BRD by providing an overview of a comprehensive period and including a perspective that complements the snapshots provided by Adler et al. (2018), Rimmel and Jonäll (2013), and van Liempd and Busch (2013). Second, we offer insight into the firm-internal drivers of high-quality BRD. Importantly, we show that the self-serving motives of managers are expanded when their attention is directed toward climate change (i.e.,

if their compensation includes climate-related incentives). In this way, we add a new perspective on the incentives of managers with respect to environmental issues. For example, Edmans (2023) suggests that ESG incentives lead managers to focus only on these specific metrics (issues), which we show empirically. Third, prior literature showed that companies exposed to high risk are more likely to disclose biodiversity management policies (Carvalho et al., 2022). We are the first to show how BRD is then incorporated in investors' risk assessments, which is a new strand in the literature on the consequences of the low quality of highly complex BRD. Our study hence adds to the literature on ESG disclosure and firm value whose analysis is mostly limited to simple indicators for overall ESG disclosures, or focuses on moderating elements, and does not examine any particular disclosure elements and topics (Mittelbach-Hörmanseder et al., 2021; Tsang et al., 2022). Lastly, we show a negative relationship between disclosure quality (i.e., compliance with the GRI framework) and impression management tactics, contrary to the literature that discourages disclosures according to GRI standards on the grounds that they do not lead to greater comparability (e.g., Boiral & Henri, 2017). Specifically, our results suggest that BRD according to GRI 304 reduces impression management, even if the content is not consistently informative and comparable.

Our study has practical implications especially for regulators, NGOs, and society at large, which should exert more pressure on companies. Specifically, our study shows that it is important to have very clear disclosure frameworks and reporting requirements. Consider the current reshaping of the ESG reporting landscape. At the EU level, the Corporate Social Responsibility Directive (CSRD) mandates the European Financial Reporting Advisory Group (EFRAG) to develop mandatory European Sustainability Reporting Standards (ESRS) (Directive (EU) 2022/2464, 2022). At the international level, the International Sustainability Standards Board (ISSB) has been established to develop ESG disclosure standards that will complement the International Financial Reporting Standards (IFRS, 2021), with BRD being part of this process. At the EU level, the ESRS foresee a phased approach that allows for qualitative disclosures when required to disclose (ESRS E4, 2022). The GRI is also in the process of updating GRI 304, while the ISSB has announced that it will develop a standard on this topic (GRI, 2022; ISSB, 2022). In this context, it is important that the respective disclosure requirements are aligned due to the inherent complexity of BRD.

The remainder of this paper is structured as follows. In the next section (Section 2), we review the literature and develop hypotheses. Section 3 outlines our methodology. In the fourth section, we present our results and conduct additional analyses. Section 5 concludes.

2. Literature Review and Hypotheses

2.1 Motives for Corporate Biodiversity-Related Disclosure

Half of global GDP depends on intact nature and ecosystems (WEF, 2020b), indicating a high dependency of the economy and society on biodiversity. With extinction at unprecedented levels (Pimm et al., 2014), biodiversity loss is considered one of the top five global risks (WEF, 2020a). Aside from the high level of dependency, the activities of society and business are the so-called root causes of the biodiversity loss drivers (i.e., land/sea use change, direct exploitation, pollution, climate change, and invasive alien species) (Díaz & Malhi, 2022). The general human alteration of ecosystems generates several biodiversity-related risks that concern the economy as a whole as well as individual companies (Dasgupta, 2021). These not only include *physical risks* such as reduced crop yields or water shortages but also, among others, *litigation* and *reputational risks*.

In this context, BRD is essential to discharge accountability toward society and other stakeholder groups (Deegan, 2002). Companies face pressure from different stakeholder groups to explain and report on their impact on biodiversity (Adler et al., 2017). In this context, the business model of a company shapes the impact and dependency of that company on biodiversity and ecosystem services. There is a distinction between *primary industries*, which have a direct impact on biodiversity and ecosystems and are dependent on ecosystem services (e.g., pollination in agriculture), and *secondary industries*, which have no direct dependencies. Furthermore, some industries (not necessarily primary) are more dependent on, and therefore more exposed to, the risks associated with an intact biodiversity (i.e., high-risk industries) (Adler et al., 2018). In particular, companies that are aware of their impacts on biodiversity attempt to maintain their legitimacy through BRD (van Liempd & Busch, 2013). The positive relationship between BRD and industry affiliation (Adler et al., 2018), size (Adler et al., 2018), and media attention (Bhattacharyya & Yang, 2019) also suggests that companies are mainly motivated by legitimation when engaging in BRD. Companies exposed to sectoral biodiversity and biodiversity policy risks are particularly likely to publish a biodiversity policy (Carvalho et al., 2022). Hassan et al. (2020) show that biodiversity partnerships and awards drive the disclosure thereon, suggesting that companies mainly follow self-serving motives of building and maintaining legitimacy through their BRD.

2.2 Corporate Biodiversity-Related Disclosure Quality

Prior studies on BRD in *primary* industries, especially mining and forestry, conclude that it is limited and shows significant room for improvement (Adler et al., 2017; Boiral & Henri, 2017; Boiral & Heras-Saizarbitoria, 2017b, 2017c; Maroun et al., 2018). Similarly, studies on BRD practices in specific regions, such as van Liempd and Busch (2013), who studied Danish companies, or Rimmel and Jonäll (2013), who analyzed Swedish companies, conclude that BRD shows scarce quality and poor information. Again similarly, Skouloudis et al. (2019) conclude that companies in high biodiversity value countries *(i.e., mega-diverse countries)* exhibit weak BRD and fail to recognize the risk of biodiversity loss. Subsequent studies that provide snapshots of the BRD practices of large companies note that there is a lack of BRD and extinction accounting according to the IUCN Red List of Threatened Species[139] for the top 150 of Fortune 500 companies (Adler et al., 2018; Hassan et al., 2022).

In addition to providing limited BRD, companies apply tactics to neutralize, rationalize, and mask their negative impacts on biodiversity (Boiral, 2016; Smith et al., 2019; Toppinen et al., 2012). For instance, the poor BRD of South African food producers often shows a tendency toward positive disclosure, avoidance of commitment, and frequent use of forward-looking analyses (Smith et al., 2019). Indeed, all the studies suggest that there is generally much scope for improvement in BRD.

According to Adler et al. (2017), the attention paid by mining companies to BRD increased after the UN declared its *Decade on Biodiversity* in 2010. Considering the continuous deterioration of biodiversity, the question is how BRD has developed since 2010, as many studies only provide snapshots of time and/or are limited to single industries. On the other hand, none of the 20 Aichi Biodiversity Targets set in 2010 have been fully achieved at the global level. Furthermore, individual country targets were poorly aligned with the Aichi Biodiversity Targets (UN, 2020), suggesting that at least at the country level, pressure has not been intense. Likewise, Moussa et al. (2021) claim that companies devote little attention to biodiversity in their environmental target declarations relative to other environmental issues. Considering the aforementioned arguments, we formulate our first empirical hypothesis in a non-directional manner:

Hypothesis 1 (H1). The quality of biodiversity-related disclosures changes over time.

[139] The annually updated International Union for Conservation of Nature ‘s (IUCN) Red List of Threatened Species contains the extinction risk of animals, fungi, and plants.

2.3 Biodiversity-Related Disclosure and Firm Level Awareness

Besides motives based on legitimacy theory (Adler et al., 2017), more recent studies suggest an intrinsic motivation of companies to engage in BRD and protect biodiversity due to their awareness of the value of biodiversity that is rooted in *deep ecology* thoughts (Samkin et al., 2014). For example, extinction accounting (i.e., the reporting on threatened species by business operations) is interpreted as rooted in this consciousness (Gaia & Jones, 2017). Besides motives to shape and maintain legitimacy, the survey by Krause et al. (2020) indicates that attitude, intrinsic motivation, and internal difficulties are crucial factors for engagement in BRD, in addition to pressure from stakeholders. Besides, Wagner (2022) suggests that internal processes (i.e., adequate quality management systems) determine engagement in biodiversity protection.

While biodiversity impacts and risks have not received much attention of companies, investors, organizations, and academia, climate risks and corporate disclosures thereon have gained attention over the last twenty years. For instance, the Carbon Disclosure Project (CDP) was launched in 2000 and began requesting climate information from firms in 2003. However, since 2019, CDP has requested information on biodiversity impacts in its forests questionnaire, which was introduced in 2010. Kim et al. (2022) suggest that facing and disclosing material climate-related risks has implications for a firm's environmental behavior. With climate change being one of the main drivers of biodiversity loss (IPBES, 2019), we expect companies with exposure to climate change and related risks to face greater societal pressure, but also internal motivation, to engage in high-quality BRD.

However, management has limited capacity and resources to respond to emerging issues (Daft & Weick, 1984). As a result, issues within the organization may be underestimated or ignored when they are not on the corporate agenda (Bansal, 2003) and other problems are considered more significant (Fu et al., 2020). In addition, focus on one particular issue may divert attention away from another (Eggers & Kaplan, 2009). This may result in less emphasis on the issue and, we would argue, less-quality BRD. Based on this, we formulate our second hypothesis in a non-directional way:

Hypothesis 2 (H2). An internal awareness of climate-related risks is related to the quality of biodiversity-related disclosure.

2.4 Biodiversity-Related Disclosure and Shareholder Perceptions

Generally, disclosure of additional information reduces asymmetric information distribution and translates into reduced uncertainty and risk as perceived by investors (Lambert et al., 2007). According to Dhaliwal et al. (2011), ESG-related disclosures reduce asymmetric information distribution, resulting in lower perceived risk and translating to lower COEC. For instance, voluntarily disclosed information on carbon emissions results in higher firm valuation (Matsumura et al., 2014). In this context, the quality of the information disclosed benefits this relationship. Cahan et al. (2016) and Clarkson et al. (2013) indicate that voluntary high-quality ESG disclosures are indeed value-relevant.

However, Plumlee et al. (2015) fail to show a negative relationship between disclosure quality and COEC. Their results suggest that the effect depends on the type (i.e., qualitative or quantitative) and nature of the disclosed information (positive, neutral, or negative), based on the argument that different types of disclosures convey different information on a firm's risk profile. For instance, high emissions, related to high climate change-related risks, are negatively associated with firm value (Matsumura et al., 2014). According to Plumlee et al. (2015), counter to theory, high-quality neutral disclosures are related to higher COEC, while high-quality positive disclosures decrease COEC. Furthermore, high-quality qualitative information with a negative connotation increases risk perceptions. Similarly, Richardson and Welker (2001) show a positive relationship between the quality of social disclosures that tend to be more qualitative and softer, and COEC. They relate this observation to a consistent bias inherent in social disclosures, as firms tend to report on their positive contribution and under-report on their negative effects, which possibly influences investors' perceptions. In this context, Mittelbach-Hörmanseder et al. (2021) state that information content is evaluated differently for individual topics.

Reports assessing the state of biodiversity and the consequences of its deterioration on society conclude that biodiversity loss is a significant risk factor for the economy as a whole (Dasgupta, 2021; IPBES, 2019). However, while academic research has shown that climate risk (Matsumura et al., 2022; Painter, 2020), carbon disclosure, and carbon performance shape investors' risk perceptions (Krueger et al., 2020), no study has so far investigated the response of investors to BRD. Existing studies suggest that companies have rather self-intrinsic motives to commit to BRD (Hassan et al., 2020) and that BRD is rather qualitative than quantitative (van Liempd & Busch, 2013). Thus, we argue that it is *ex-ante* unclear whether the quality of BRD positively or negatively affects a company's COEC. Based on this, we formulate our third hypothesis in a non-directional manner:

Hypothesis 3 (H3). The quality of biodiversity-related disclosure influences investors' risk perceptions.

3. Methodology

3.1 Global Reporting Initiative and Biodiversity-Related Disclosure

According to the KPMG (2022) Sustainability Reporting Survey, 96 percent of the world's 250 largest companies report on ESG issues. Of these, 75 percent follow the disclosure standards of the GRI. Despite criticism of the application and the GRI framework (Boiral, 2016), GRI remains one of the most widely used frameworks for BRD (Maroun & Atkins, 2021). GRI 304 stipulates four disclosure requirements for biodiversity (see Table V-1) (GRI, 2016). For companies that identify biodiversity as a material topic and apply the GRI standards comprehensively, all disclosures of GRI 304 are required under the GRI framework. One item is required for companies applying GRI at the core option.

3.2 Content Analysis of Biodiversity-Related Disclosure

In assessing the quality of BRD, we consider the nature of the information related to biodiversity that is disclosed according to the four specific GRI 304 criteria, following the approach of Michelon et al. (2015). Each item is assigned three points for quantitative information and two points for qualitative information.[140] In addition, for companies that state they comply with one of the GRI 304 items but do not provide the required content, we assign a score of 1. If there is no mention of the disclosure requirement, the score is 0.

The most recent version of the GRI topic-specific biodiversity disclosure is GRI 304, part of the GRI standards, so we use this as the basis for our assessment. However, between 2010 and 2019, there were two updates to the GRI reporting framework, so we compared the disclosure requirements of GRI to the topics covered by GRI 3.1 and G4. There are no significant differences between the G4 and the GRI standards. The transition from G3.1 to G4 was an organizational change rather than a content update (Adler et al., 2017). The different versions are hence largely comparable with respect to biodiversity-related disclosures. Table V-1 presents how the versions of the GRI standards are mapped. Next, we develop and review a template for assessing the information in the reports. We assess the quality of the template and

[140] Michelon et al. (2015) assign three points for monetary disclosures, two points for quantitative disclosures, and one point for qualitative disclosures. As the pre-audited ESG disclosures made no reference to monetary terms (in the case of the company), we did not assign three points.

discuss any ambiguities during data collection. Two research assistants, working with two co-authors, conduct the data collection.[141] The approach is conservative (i.e., the lower value is assigned whenever there is ambiguity).

3.3 Selection of the ESG Reports for Content Analysis

The sample drawn includes all available ESG-related reports collected by Corporate Register from 2010 to 2019 for all companies that have reported to the CDP at least once in the past (14,802 ESG reports).[142] Our argument is that companies are more likely to disclose biodiversity information in their ESG reports if they are aware of the importance of climate change.[143] In addition, we restrict the sample to reports for which there is a match with the annual files of the Compustat database (North America and Global) (less 4,847 reports). Next, due to differences in general nature, behavior, and exposure to biodiversity risks, we exclude companies in the financial sector (less 310 reports). To further reduce hand-collection costs, we pre-screen reports using a Python program to identify company-specific ESG disclosures that include at least the regular string *biodiversity* to pick out reports that included biodiversity disclosures (less 3,388 reports). In addition, we count the number of biodiversity-related words in the ESG reports in accordance with the Adler et al. (2018) word list. We narrow the analysis to the top three company ESG related disclosures in terms of biodiversity-related word mentions, as in some cases the Corporate Register database provides more than one publication per company and year (less 40 reports). We analyze the reports published by each company with a deflated median of total assets greater than the deflated median total assets of the country in which the company is located, as Adler et al. (2018) show that company size is an important driver of biodiversity-related disclosures (leading us to exclude 2,654 reports). For the empirical analysis, we focus on the ESG disclosure with the highest coverage of biodiversity (338 reports excluded).[144] Since companies from all over the world respond to the CDP questionnaires, the resulting sample comprises 2,505 firm years from 440 companies across 43 countries. The report selection procedure is summarized in Table V-2.

[141] We also conducted within-coding validity checks with separate coding of the same disclosures to ensure consistent coding across the sample.

[142] Meaning all available ESG reports published between 2010 and 2019.

[143] Further, we use the completion of the CDP questionnaire as variable of interest.

[144] The wordlist includes 30 words covering a wide range of biodiversity and species conservation activities commonly undertaken: "Ecosystem," "Wildlife," "Species," "Forest," "Flora," "Fauna," "Marine," "Wetlands," "Threatened," "Vulnerable," "Endangered," "Extinct," "Accident" (relating to damage or death to environment/ species), "Habitat," "Conservation," "Protected area/preservation/protection," "Rehabilitation" (land, soil, etc.), "Vegetation," "Groundwater," "Biodiversity corridor," "Biodiversity offset," "Floral and/or faunal wealth," and "Biological diversity."

3.4 Measures of the Quality of Biodiversity-Related Disclosure

After assessing the biodiversity-related disclosures, we derive a quality biodiversity-related disclosure score *BRD_QL*. *BRD_QL* is the sum of the four reporting requirements according to GRI 304 (*ITEM)* multiplied with the respective values reflecting the disclosure quality of that specific GRI 304 reporting requirement (*QUALITY*). This sum is divided by the sum of items multiplied with the maximum quality value (maximum possible value):

$$BRD\_QL_{i,t} = \frac{\sum ITEM_{i,t} \times QUALITY_{i,t}}{4 \times 3} \quad (1)$$

We also consider two alternative definitions. First, we increase the nominator by one if a company discloses information on its management approach with respect to biodiversity as a material issue. This increases the maximum possible value (denominator) by one. Second, we consider whether a company refers to a biodiversity strategy in the management approach, in addition to the management approach disclosure. Again, we add a possible count to the nominator. This again increases the maximum possible value (denominator) by one. See Appendix A for details regarding the two alternatives of *BRD_QL*. To test our first hypothesis, we inspect the development of *BRD_QL* over the sample period.

3.5 Model testing the Motivation for Biodiversity-Related Disclosure

According to our second hypothesis, we are interested in whether a firm's awareness of environmental topics increases BRD quality. For this, we run an ordinary least squared (OLS) regression on the following equation:

$$BRD\_QL_{i,t} = \alpha + \beta_{i,t} CDPQ_{i,t-1} + \sum CONTROLS_{i,t} + COUNTRY\ FE + YEAR\ FE + INDUSTRY\ FE + \epsilon_{i,t}, \quad (2)$$

with *BRD_QL* as dependent variable. *CDPQ* is an indicator equal to one if a company filed the CDP questionnaire in the prior year, hence capturing a company's internal awareness of climate-related risks, and zero otherwise (Jung et al., 2018).[145] We additionally control for firm-level specific factors determining disclosure on environmental topics, such as size (*SIZE)* (Adler et al., 2018), financial structure (*LEV)*, profitability (*ROA)* (Bhattacharyya & Yang, 2019), capital intensity (*CAPINT)* (Haque & Jones, 2020), future investment opportunities *(MTB)* (Haque & Jones, 2020), and the overall ESG performance (*ESG*) of a company (Hassan et al., 2020, 2022). Additionally, we include country-level variables such as changes in country-level GDP *(D_GDP)*, rate of inflation (*INFLATION*), level of control of corruption (*CORR*),

[145] We use the lagged version of the *CDPQ* variable to establish more of a causal relationship in this direction, as other studies have done before with the dependent and independent variable relationship.

and country-level carbon emissions *(CL_CO*2) (Roberts et al., 2021). Further, we include country, industry, and year-fixed effects.[146] Continuous variables are winsorized at the extreme values of 1 and 99 percent (except for scores). All variables are defined in Appendix A.

3.6 Model testing the Association of Biodiversity-Related Disclosure and Investor Risk Perceptions

To test the association between investors' risk perceptions and BRD, we run on the following OLS model:

$$COEC_{i,t+1} = \alpha + \beta_1 BRD\_QL_{i,t} + \sum \beta_k CONTROLS_{i,t} + FIRM\ FE_i + YEAR\ FE_t + \epsilon_{i,t+1}, \quad (3)$$

where *COEC* is the average of five different implied COEC measures derived following the approach from Hou et al. (2012) and similar other studies investigating corporate disclosures (e.g., Athanasakou et al., 2020). As implied COEC measures are prone to measurement errors, we derive COEC according to five different models and follow prior literature that uses implied COEC to capture investors' perceptions of risk (e.g., Dhaliwal et al. (2016). We control for the quantity of BRD by including the natural logarithm of the number of the biodiversity-related words according to the wordlist by Adler et al. (2018) (*BIO_WORDS)*[147] and the logarithm of the total number of words mentioned in the ESG disclosure (*TOTAL_WORDS)*. We include firm level accounting measures such as size (*SIZE)* to capture a company's visibility and the market to book ratio (*MTB)* to account for investment opportunities. Moreover, we include country level measures such as the growth in GDP (*D_GDP)* and the inflation rate *(INFLATION)* (El Ghoul et al., 2018), plus overall ESG performance (*ESG)* (El Ghoul et al., 2018). We also include the company's commitment to combat climate change, such as answering the CDP questionnaire (*CDPQ).* Furthermore, we include a dummy variable equal to one if a company states in their ESG disclosures that they have implemented a climate strategy (*MGMT_CL).* To alleviate time-invariant industry and country specific characteristics, we include industry fixed effects according to the two first letters of the SIC code and country fixed effects. To account for temporal events, we include year fixed effects. All variables are defined as in Appendix A.

[146] Since previous research found differences especially across industries and countries, we account for these using industry and country fixed effects. To account for temporal events, we include year dummies in the regression analysis.

[147] For logarithmic variables, to avoid losing observations with a value of zero, the initial value plus one is often taken. However, this is not necessary for the variable *BIO_WORDS*, as we only have companies with an ESG report that contains the word "biodiversity" at least once, which is also one of the words related to biodiversity according to Adler et al. (2018). Hence, the value from which the logarithm is derived is always greater than or equal to one.

4. Results Section

4.1 The Quality of Biodiversity-Related Disclosure over Time

Figure V-1 reveals that among the 1,947 observations which report according to GRI and mention the term "biodiversity" in their disclosure, 938 companies (48.18 percent) report that they provide disclosure according to GRI criterion 304-1. The percentages for GRI 304-2 and GRI 304-3 show similar levels, with 994 (51.05 percent) and 909 (46.69 percent), respectively. Item GRI 304-4 exhibits a significantly lower percentage, namely 26.04 percent (507). Altogether, the proportion of these biodiversity-related disclosures that include quantitative disclosures according to the GRI framework is 35.29 percent for item GRI 304-1, 34.98 percent for item GRI 304-2, and 41.22 percent for item GRI 304-4 (Figure V-1). We also observe that companies disclose GRI 304 item 1 but not item 2 (106) in the same report and year. By contrast, some companies disclose GRI 304 item 2 but not GRI 304 item 1 (162), highlighting that GRI 304 is not strictly applied.

Table V-3 includes the quality assessment for the four GRI 304 items. The mean quality of GRI 304-1 is 0.952. Item GRI 304-2 shows an overall mean quality of 0.975, for GRI 304-3 the mean quality is 0.939, and for GRI 304-4 the mean quality is 0.519, indicating that the disclosure for all four GRI 304 items tends to be, where applicable, qualitative in nature (Table 3, Panel A). Further, Table V-3, Panel A provides summary statistics of the aggregated quality scores (*BRD_QL)*. For the first version *BRD_QL_1*, the mean is 0.282, not even reaching one-third of the upper limit of 1. If the management approach (and the establishment of a biodiversity strategy) is considered in *BRD_QL_2* (*BRD_QL_3*), the score drops to 0.278 (0.261). This indicates that overall BRD is poor according to the GRI guidelines. A t-test on the differences in the means of the subsamples is presented in Table V-3, Panels B to E. Companies from primary industries and high-risk firms also have higher BRD quality according to the t-statistics. In addition, firms headquartered in developed countries tend to have higher BRD quality. With regard to the time perspective, we split the sample period into half (i.e., 2010-2014 vs. 2015-2019). The t-statistic shows significance for *BRD_QL_1* at the five percent level, indicating lower BRD quality in the more recent period (2015-2019). However, this effect loses significance when considering the reporting on the management approach (and the establishment of a biodiversity strategy) in *BRD_QL_2 (BRD_QL_3)*. This indicates that BRD on topic-specific items has declined, however, firm focus on management approach and strategy (i.e., the reporting thereon) has increased from the firm side.

Figure V-2 reflects how BRD quality varies over time. Graph (a) shows the overall trend in BRD quality. The time pattern suggests a small increase followed by a steady decline. Graphs (b), (c), and (d) inspect the time pattern for sub-groups identified by prior literature as being exposed to biodiversity risks. Graph (c) and graph (d) suggest that companies in primary and high-risk industries tend to have higher BRD quality, however, suggesting a downward trend. Chart (b), distinguishing between companies headquartered in developed and developing regions, indicates an increasing trend in BRD quality for companies headquartered in developing countries. However, companies located in developed countries show a declining pattern.[148] Overall the results support our first hypothesis which suggests a change over time in BRD quality. Moreover, the aggregated measures suppose a decline in BRD quality.

4.2 Quantitative Measures in Biodiversity-Related Disclosure

Even though the overall assessment shows that BRD reporting is largely qualitative, we attempt to further inspect the quantitative metrics according to the topic-specific GRI 304 disclosures. Table V-4 provides a summary of the quantitative metrics collected from the respective biodiversity-related disclosures. Table V-4, Panel A shows the area of operational sites in accordance with GRI 304-1. For all the disclosures that refer to a unit of area, we convert the amount to hectares (ha). However, we find that companies also report this information expressed in length (km or m), number of sites, percentages, or pieces. In one case, there was no indication of the unit of measurement. Out of the 331 numbers reported, we were only able to convert 249 into hectares. Here, the mean value is 125,777.061 hectares with a high standard deviation of 370,072.940 hectares. We make similar observations with respect to the disclosure of the area of protected habitats in accordance with GRI 304-3 (see Table V-4, Panel B). Companies generally report in units of area. We convert this to hectares. Again, they report units of length (km and m) and pieces and again, the mean is high at 309,460.591 ha. Similarly, the standard deviation exhibits a high value of 1,996,426.100 ha. 208 companies report on threatened species. The mean is 177.279 and the standard deviation is 363.249 (Table V-4, Panel C).

Panels D to G present two-sample t-tests. Panel D indicates no significant differences in mean values between the values reported by companies in primary and secondary industries.

[148] In addition, we run probit regressions for disclosure by each of the GRI 304 items. The results show the same pattern as the t-test for the means. Being in a high-risk industry increases the probability of BRD. Apart from GRI 304-4, originating in a developed region also increases the likelihood of disclosure for items GRI 304-1, GRI 304-2, and GRI 304-3. The period prior to 2015 also increases the probability of disclosure of the items GRI 304-1 and GRI 304-2.

By contrast, Panel E shows the differences between high-risk and low-risk companies, suggesting that high-risk companies report much higher values according to GRI 304-1. This is in line with high-risk companies tending to be involved in activities that depend on or affect biodiversity. Curiously, companies headquartered in developing countries report higher values for protected habitats (Panel F). This may be since developing regions also contain larger areas of high biodiversity value. Companies headquartered in developed regions, on the other hand, report significantly higher numbers of threatened species affected by their operations (Panel F). Panel G shows the difference between the periods 2010-2014 and 2015-2019. It shows an increase in area affected by business operations (GRI 304-1) and a decrease in protected habitats (GRI 304-3). This could be attributed to an overall increase in business activities and reduced corporate activities to protect habitats.

In summary, the analysis of biodiversity disclosure under GRI 304 shows that the standard is not comprehensively followed (i.e., some disclosures are not made and only selected disclosures are stated). In addition, there are still companies that refer to biodiversity and reference GRI without referencing and aligning their BRD with GRI 304. Neither the rate at which they are adapting, nor the amount of information provided increase throughout our sample period, which does not indicate a growing interest among companies. Thus, we find weak support for our first hypothesis, indicating that BRD quality indeed develops, although the quality of the BRD is rather on the decline. Moreover, when looking at the disclosure of quantitative indicators according to the standards (GRI 304-1, GRI 304-3, and GRI 304-4), the comparability is questionable.

4.3 Motivation of Biodiversity-Related Disclosure

Next, we analyze the internal drivers of BRD quality. Table V-5, columns (1) to (3) present the regression coefficients of the model in Eq. (2) for the different definitions of *BRD_QL*.[149] The coefficient of *CDPQ* in column (1) is positive and significant (0.030, *p-val < 0.10*). Columns (2) and (3) contain similar values. The positive coefficients indicate a positive relationship between a company's motivation to enhance its BRD when disclosing information on other relevant emerging issues (i.e., climate-related disclosures), supporting our second hypothesis. The positive coefficients on *ESG* in the columns (1) to (3) indicate that companies with an overall strong ESG performance also engage actively in BRD.

[149] Due to data availability for the required control variables, the sample is reduced to 1,676 firm-year observations. We provide summary statistics in Appendix B.

To achieve a more nuanced view of the internal forces driving BRD quality, we decompose the variable that captures climate awareness to gain a deeper understanding of companies' motivations for providing good-quality BRD. Accordingly, we replace the *CDPQ* indicator with three variables collected from the CDP questionnaires. First, we add an indicator for board oversight (*BO*) equal to one if responsibility regarding climate issues lies at the executive level, zero otherwise. The next indicator for climate risks (*CR)* is equal to one if the company discloses that they face material climate change-related risks, zero otherwise. Lastly, we include a climate incentives (*CI)* variable that equals one if executive compensation is linked to climate change-related measures (such as reductions in carbon emissions).

Table V-5, columns (4) to (6) contain the analysis of the disaggregation of the *CDPQ* variable. The coefficients on *BO* are insignificant at a frequently applied level of statistical significance. The coefficient in column (4) on *CR* is positive and significant (0.088, $p < 0.01$), suggesting that companies that recognize material climate risks also place more emphasis to BRD. The coefficients on *CI* appear negative and significant (-0.093, $p < 0.01$). In this context, tying executives' attention to one specific environmental topic could lead them to neglect other environmental topics that are not considered *quantifiable* and hence are not included in their incentive contract (i.e., BRD). Edmans (2023), for instance, highlights that ESG-linked pay may shift attention only to those ESG topics that are mentioned in the contract, meaning others are neglected. This further supports our second hypothesis, as awareness of material climate related risks is related to BRD quality.

4.4 Shareholder Perceptions of Biodiversity-Related Disclosure

After showing that BRD in general is limited, not of high quality, and lacks comparability, we investigate whether BRD quality is recognized by one group of the intended users of ESG disclosures (i.e., shareholders). Table V-6, columns (1), (5), and (9) contain the results of Eq. (3) for the three measures of BRD quality.[150] For all three measures, the coefficient on our variables of interest (*BRD_QL)* is positive ranging from 0.039 to 0.041 ($p\text{-}val < 0.05$). Higher BRD quality is therefore associated with higher perceived risk by investors, giving support to our third hypothesis. High BRD quality could be more likely to be interpreted by investors either as higher exposure to biodiversity risks (Plumlee et al., 2015) or as associated with a bias driven by impression management tactics related to higher perceptions of reporting costs (Richardson & Welker, 2001).

[150] Due to data availability for the required control variables the sample is reduced to 1,359 firm year observations. We provide summary statistics in Appendix B.

As shown in the prior section, several firm internal characteristics determine whether a company engages in BRD according to GRI 304. We correct for this potential endogeneity issue by applying entropy score balancing as proposed by Hainmueller (2012) and as applied by studies facing similar issues such as Wilde (2017). Table V-6, columns (2), (6), (10) contain coefficients derived from regressions on Eq. (3) considering analytical weights derived via entropy score balancing. All coefficients on *BRD_QL* remain positive and significant.

Surprisingly, our proxy for the quantity of BRD (*BIO_WORDS*), the number of biodiversity-related words, is negative and significant.[151] Hence both quantity and quality of BRD seem to be important to deliver information to the capital market. Thus, we further inspect the relationship between these two variables. We include the interaction of *BRD_QL x BIO_WORDS* in Eq. (3). The overall magnitude of the BRD quality (*BRD_QL)* relationship and its level of significance depends on the specific values of the BRD quantity (*BIO_WORDS*) because we use an interaction term involving two continuous variables. Whether the relationship remains significant or not may depend on the values of BRD quantity (*BIO_WORDS)*. For this reason, we analyze the interaction relationships graphically.[152] In addition to the classic results table, we show the exact significance intervals for *BIO_WORDS*. With only the results table, we would not be able to provide significance intervals for the marginal relationships between the interaction term elements (e.g., *BRD_QL*). This is because the significance of the marginal relationships is a joint function not only of its coefficient estimate and variance, but also of the other coefficient estimates (*BIO_WORDS*, *BIO WORDS x BRD_QL*), their variances and covariances (Aiken & West, 1996). In the case of negative covariances between coefficient estimates, insignificant constitutive interaction terms can still result in ranges of significance for the interaction term elements (Brambor et al., 2006).

Figure V-3 displays the marginal relationship of BRD quality on the next period's levels of cost of equity (x-axis) depending on BRD quantity (y-axis). The figure suggests that the marginal effect of BRD quality on the next period's level of COEC is positive if the variable *BIO_WORDS*, our proxy for BRD quantity, is above a value of 4 (around 70 percent of the included observations show a value larger than this; the sample mean is around 4.3). We interpret this as meaning that in addition to BRD quality, a sufficient level of BRD quantity is required so that a marginal increase in BRD quality results in higher COEC. This hints that investors are only aware of biodiversity-related risks if companies report sufficiently on them.

[151] After correcting for potential differences between companies that apply GRI 304 and companies that do not use GRI 304.

[152] Since we are using moderating variables of self-constructed score variables, we focus on interpreting the direction of the relationships rather than their magnitudes (Hartmann & Moers, 1999).

4.5 Additional Analysis

4.5.1 Biodiversity-Related Disclosure and Stakeholder Perceptions

Our main analysis reveals that the quality of BRD according to GRI 304 is limited and associated with a higher risk perception by the capital market. In an additional analysis, we investigate broader stakeholder perception of BRD. Prior research shows that companies use BRD as an impression management tool rather than to share substantial information (Smith et al., 2019). Given the overall low quality and quantity of BRD, we expect a negative or less pronounced towards BRD quality. We follow Schloetzer et al. (2021) and use the sentiment in news articles related to a specific company to grasp stakeholder responses to society- and environment-related events from RavenPack. For each firm-year, we average the sentiment score across all news articles on that company in the respective year. We are able to identify 585 matches in our database. Next, we change the dependent variable in Eq. (3) to sentiment in the following year (*SENT)*. We additionally control for the number of news articles (*ID)* published on a company each year.

Table V-7 contains the results of the OLS regression showing the relationship between BRD quality and the firm's reputation captured by *SENT*. Columns (1) to (3) indicate that there is a significant and positive relationship between BRD quality and stakeholder perceptions. The coefficients are positive and significant at a five percent level, suggesting that stakeholders positively evaluate BRD according to GRI 304. In column (4), we replace the BRD quality score with *QUANT*, indicating whether a company uses quantitative numbers in its BRD. Again, the coefficient turns out to be positive and significant at the five percent level (0.062, *p-val < 0.05*). This supports the suggestion that BRD shows low comparability. Thus, stakeholders use, e.g., the existence of quantitative measures reported to assess the quality and credibility of BRD.

4.5.2 The Effect of GRI 304 on Qualitative Disclosures

The previous analysis suggests that stakeholder response is positive versus negative investor response when the quality of BRD is high according to the GRI. Consistent with other studies, our results show that GRI 304 is more qualitative in nature, which could result in negative reactions also from wider stakeholder groups. Thus, we analyze whether BRD according to GRI 304 diminishes disclosure tactics of impression management (i.e., positive, forward-looking, no commitment) (Smith et al., 2019).

We use a Python program to inspect the tone, number of forward-looking statements, and uncertain phrases in sentences related to biodiversity. Following prior studies, we apply a bag of words approach. We identify sentences related to biodiversity using the wordlist of Adler et al. (2018). Additionally, we baseline the qualitative disclosure of biodiversity to the qualitative disclosure on climate change. To identify climate change-related disclosure, we use two wordlists from Kim et al. (2022) and Matsumura et al. (2022). In each of the biodiversity (climate) sentences we count the positive, negative, forward-looking, and uncertainty phrases according to wordlists established by Loughran and McDonald (2011) and Bozanic et al. (2018). We calculate tone as the number of positive words minus the number of negative words (related to biodiversity/climate) divided by the total sum of positive and negative words (related to biodiversity/climate). When investigating forward-looking statements as well as uncertainty phrases, we account for the individual amount of biodiversity (climate) disclosure by dividing the number of forward-looking statements and uncertainty phrases in biodiversity (climate) sentences by the number of biodiversity (climate) related words in the disclosure.

Figure V-4, Graph (a) depicts the frequency of biodiversity (climate) related words. Over time, the frequency of biodiversity-related words declines while the frequency of climate-related words increases. Graph (b) contains the trend of tone in biodiversity and climate-related sentences, suggesting that BRD tends to be more negative than both overall ESG and climate-related disclosure. Regarding forward-looking statements (Graph (c) and statements of uncertainty (Graph (d), sentences related to biodiversity show stronger use of forward-looking statements and statements of uncertainty rising over time. Next, we examine the relationship between the BRD quality score (*BRD_QL*) and the use of tone, forward-looking statements, and uncertainty phrases. Table V-8 displays the results. The regression coefficients of *BRD_QL* suggest a negative relationship between the quality of BRD and the use of positive tone, forward-looking statements, and uncertain phrases, with significance at the one percent level. This indicates a negative relationship between the application of impression management tactics in BRD and the consistent application of GRI 304.

5. Conclusion

Covering ESG reports published between 2010 and 2019, our study suggests that the quality of BRD according to the topic-specific GRI 304 standard has decreased over the past decade. Companies that self-identify as impacted by climate risks also exhibit a higher disclosure quality on emerging environmental issues (i.e., biodiversity) besides climate change. However, our results indicate that providing climate change-related incentives to managers could cause them

to focus too much on one environmental issue, causing them to lose perspective. In light of the low quality and quantity of BRD, our analysis of investors' risk perceptions shows that higher quality BRD is associated with higher perceived risks (i.e., an increase in the next period's COEC). In an additional analysis, we show that wider stakeholder groups value high-quality BRD as well as quantitative BRD. Further, we demonstrate a relationship between BRD quality according to GRI 304 and the application of a negative tone, fewer forward-looking statements, and less uncertain wording in their BRD, indicating that the successful application of frameworks decreases impression management.

Our results contribute to the literature on the quality and quantity of BRD by giving an overview of a comprehensive time span and a perspective that complements the snapshot given by Adler et al. (2018). Furthermore, we offer insight into the drivers of low-quality BRD. Importantly, we show that managers' self-serving motives are expanded when their attention is focused on climate change, adding a new perspective on managers' incentives toward environmental issues. In addition, we are the first to show that investors consider BRD, which is a new strand in the literature when examining the consequences of complex BRD. Finally, we show a negative relationship between BRD quality (i.e., compliance with the framework) and impression management, adding another perspective to the literature on the overall application of the GRI standards (Boiral, 2016). We show that GRI 304 application is associated with less impression management even when the content is not consistently comparable.

Our study provides practical implications for regulators, non-governmental organizations, and society to exert more pressure on companies to create transparency on their biodiversity-related activities. Furthermore, we show that clear frameworks and reporting requirements matter, even if they only refer to qualitative disclosures. This is especially important as the global ESG reporting landscape is currently moving towards more granular mandatory disclosure. Due to the inherent complexity of the issue, it is essential that the disclosure requirements of the different frameworks and standards be consistent. Furthermore, there is a need for more in-depth verification by an external party as to whether the disclosing company applies and complies with the relevant (GRI topic-specific) standards.

There are some limitations to our empirical analysis and findings. Other studies have gathered a larger amount of information when assessing the extent of biodiversity disclosure, for example Adler et al. (2017). However, there are two underlying motives for this. First, it appears that including other frameworks would no longer be an assessment of the existing GRI framework, that includes those disclosure items. Second, one could argue that limited BRD would not have led to more findings had we assessed more items. In light of the upcoming

fundamental changes to ESG reporting and the political emphasis on biodiversity, we encourage future research to assess companies' future BRD based on the new standards as they come into force. Moreover, our sample ends before the beginning of the COVID-19 pandemic in 2020. According to Hassan et al. (2022), companies adjusted their disclosure on their websites in response to the pandemic. Thus, an extension of the sample period in this paper could be a focus of future research.

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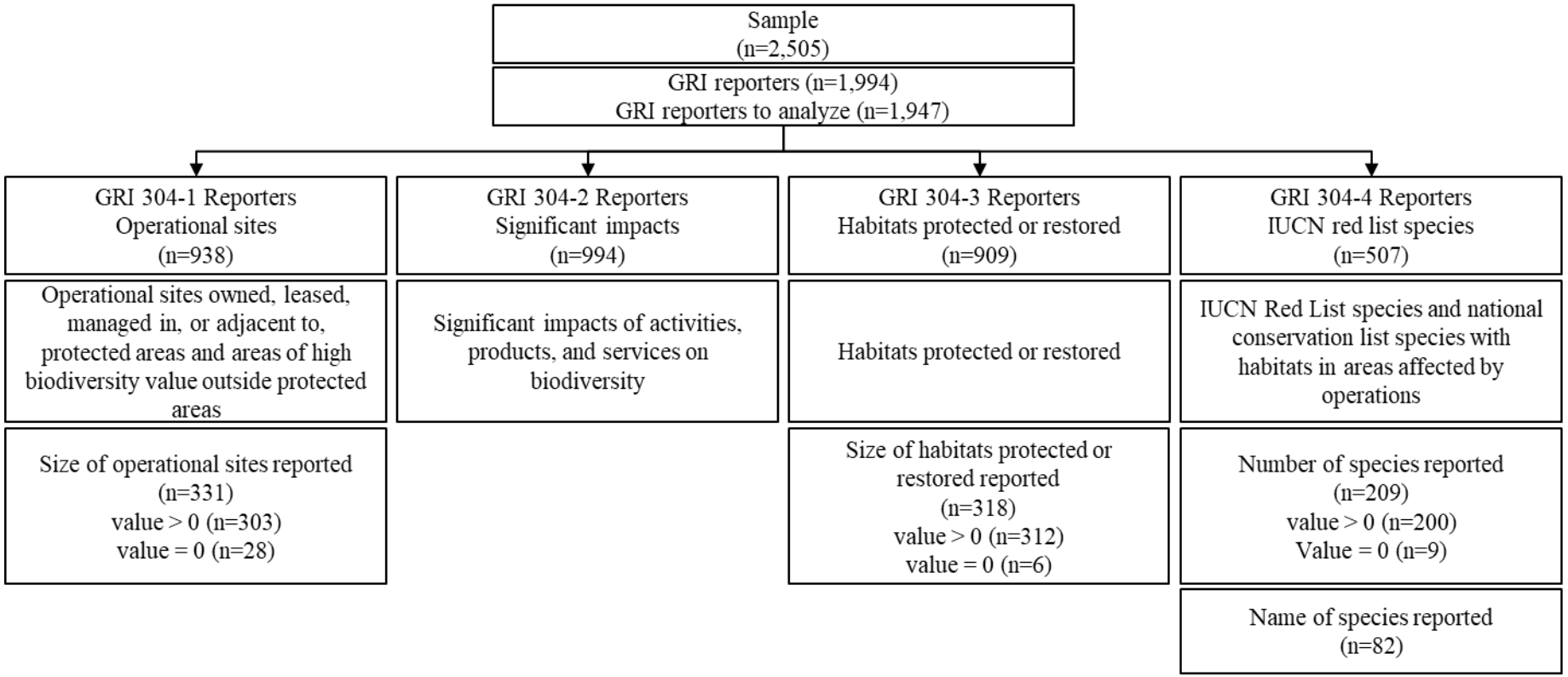
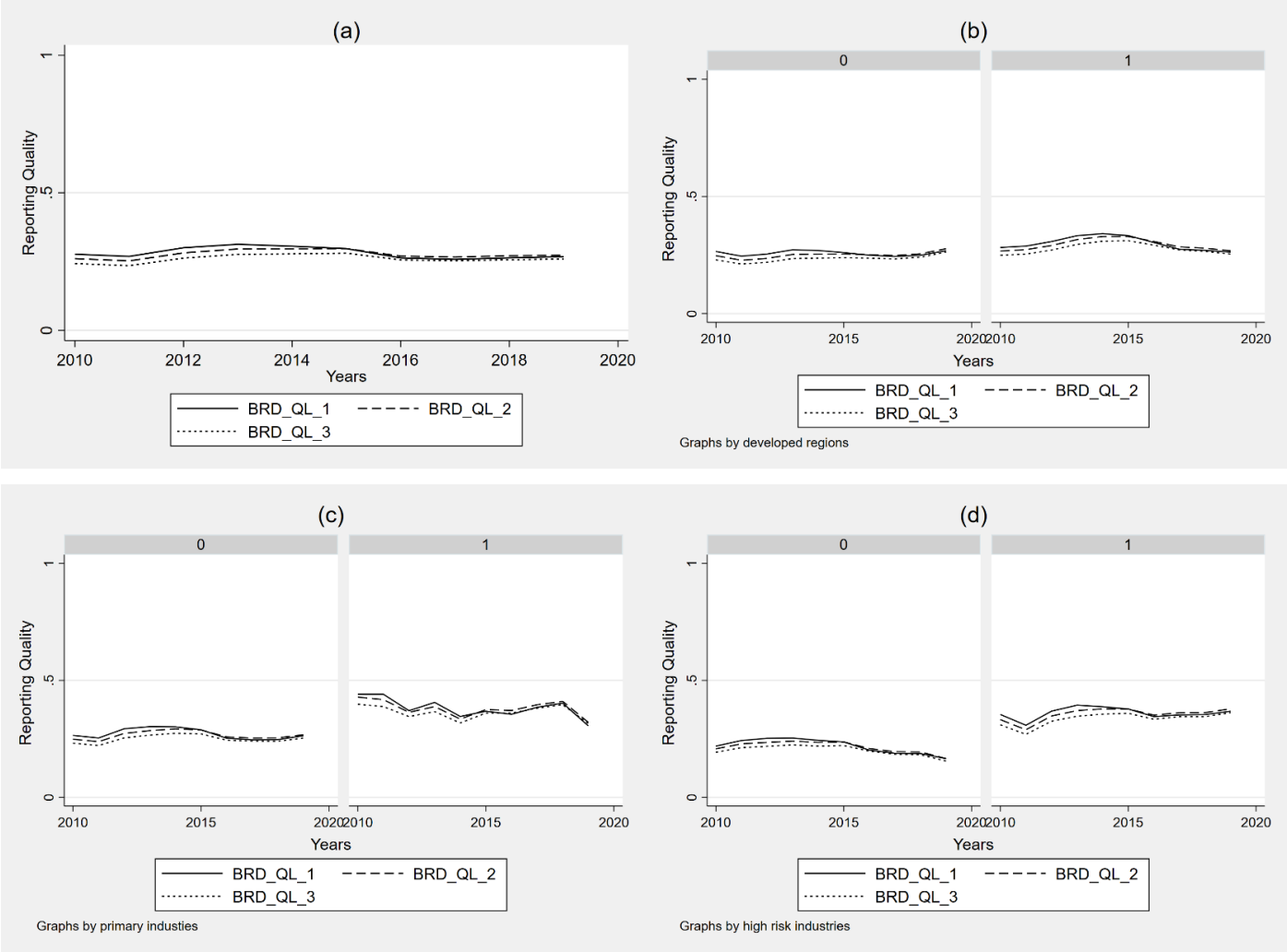
Figure V-1: Hand collection on biodiversity-related disclosures according to GRI 304



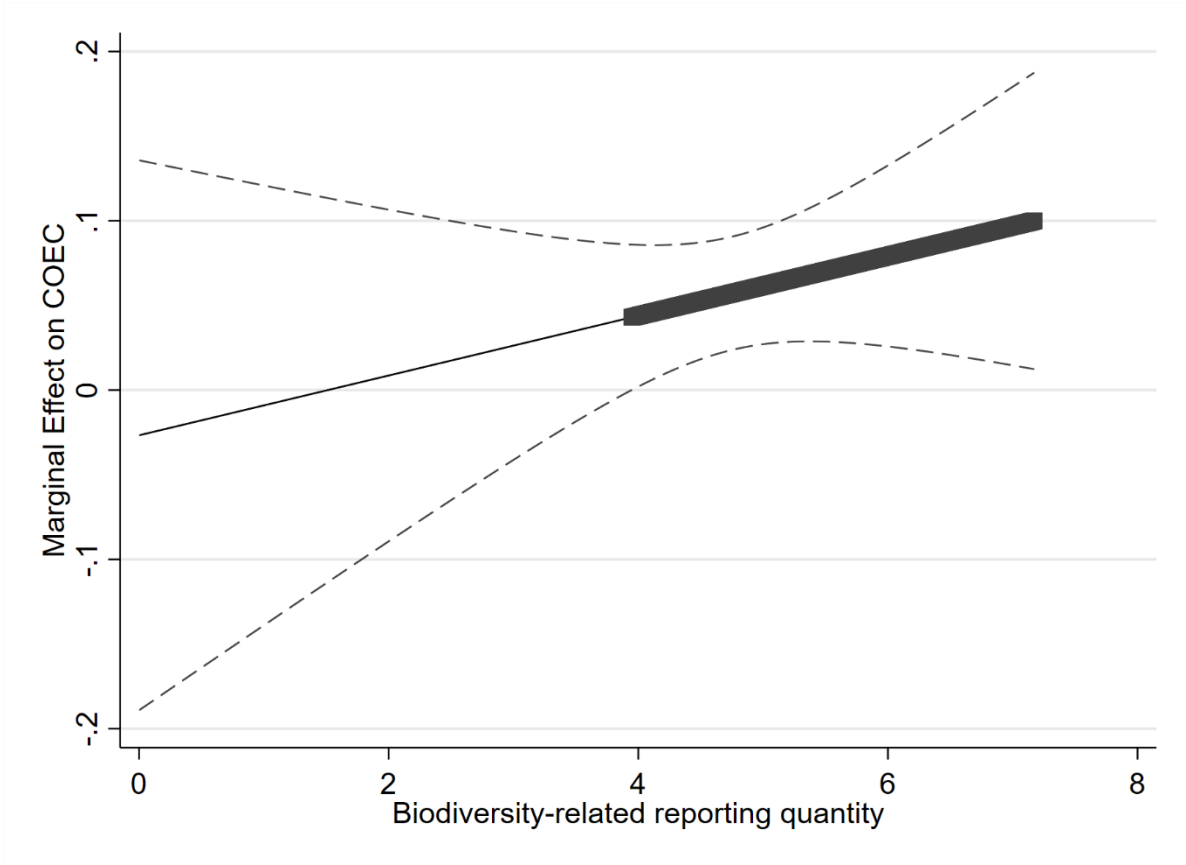
This figure shows the results of the manual data collection used to assess the sustainability disclosures (single company level). Of the 2,505 reports in the analysis, 1,994 were GRI reports. The sample is trimmed to 1,947 because these reports referred to GRI only once and did not refer to GRI throughout the report.

Figure V-2: Development of BRD quality according to GRI



This figure shows the development over time for BRD as a whole (graph a), for developed (1) and developing regions (0) (graph b), for primary (1) and secondary (0) industries (graph c), and for low-risk (0) and high-risk industries (1) (graph d). All variables are defined as in Appendix A.

Figure V-3: Marginal effect of BRD quality on CEOC depending on levels of BRD quantity (BIO_WORDS)



This figure shows the marginal effect of BRD quality (*BRD_QL_1*) on next period's cost of equity (*COEC*) depending on BRD quantity (*BIO_WORDS*). The full line indicates the marginal effect of BRD quality on next period's cost of equity depending on BRD quantity levels. Values of BRD quantity levels for which we find a significant marginal effect of BRD quality on next period's cost of equity at the ten percent significance level are indicated with a bold line above the line indicating the marginal effect. The dashed lines indicate the upper (lower) threshold for a ten percent significance interval.

Figure V-4: Textual analysis of qualitative BRD

This figure shows the textual analysis of BRD and climate-related disclosures. Graph (a) shows the percent level of word usage over time in the respective ESG disclosure. Graph (b) shows the level of tone in the BRD, climate-related, and overall sustainability disclosure. Graph (c) (Graph (d)) shows the frequency of the usage of forward-looking (FO) (uncertainty (UN)) phrases in relation to the frequency of BRD and climate-related disclosures. All variables are defined as in Annex A.

Table V-1: Biodiversity related reporting in the versions of the GRI standards

GRI 304: Biodiversity		
GRI disclosure item	Content	Map with prior framework versions G4 and G 3.1
103	Management approach disclosures	Guidance (G4)/ EN14 (G3.1)
304-1	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	EN11 (G4)/ EN11 (G3.1)
304-2	Significant impacts of activities, products, and services on biodiversity	EN12 (G4)/ EN12 (G3.1)
304-3	Habitats protected or restored	EN13 (G4)/ EN13 (G3.1)
304-4	IUCN Red List species and national conservation list species with habitats in areas affected by operations	EN14 (G4) / EN15 (G3.1)

This table shows the mapping of biodiversity-related items according to the GRI reporting standards to the prior versions G4 and G3.1.

Table V-2: Selection of reports for content analysis

		No. of reports	No. of firm-years
(1)	Reports available in Corporate Register database of firms which report to the CDP (2010-2019).	14,082	
(2)	Less reports of which no firm-year from Compustat annual files (with available measures for CPI adjusted total assets and sales).	9,235	8,057
(3)	Exclusion of financial companies.	8,925	7,787
(4)	Less reports without the regular expression *biodiversity*.	5,537	4,971
(5)	Per company we analyze the three ESG disclosures containing the most biodiversity-related words according to the wordlist of Adler et al. (2018).	5,497	4,971
(6)	Reports of firms with median total assets above the country median.	2,843	2,505

This table includes the sample selection procedure.

Table V-3: Descriptive analysis of the quality of biodiversity-related reporting according to GRI 304

Panel A: BRD Quality - Whole Sample			
Variables	N	Mean	S.D.
GRI 304-1	1,947	0.952	1.060
GRI 304-2	1,947	0.975	0.996
GRI 304-3	1,947	0.939	1.065
GRI 304-4	1,947	0.519	0.914
BRD_QL_1	1,947	0.282	0.279
BRD_QL_2	1,947	0.278	0.270
BRD_QL_3	1,947	0.261	0.255

Panel B: BRD Quality - Primary vs. Secondary Industry					
	Primary		Secondary		
Variables	N	Mean	N	Mean	t-statistic
BRD_QL_1	186	0.379	1,761	0.272	-5.040***
BRD_QL_2	186	0.379	1,761	0.267	-5.423***
BRD_QL_3	186	0.363	1,761	0.251	-5.740***

Panel C: BRD Quality - High vs. Low Risk					
	High risk		Low risk		
Variables	N	Mean	N	Mean	t-statistic
BRD_QL_1	840	0.362	1,107	0.221	-11.404***
BRD_QL_2	840	0.358	1,107	0.217	-11.729***
BRD_QL_3	840	0.338	1,107	0.203	-11.959***

Panel D: BRD Quality - Developed vs. Developing Regions					
	Developed		Developing		
Variables	N	Mean	N	Mean	t-statistic
BRD_QL_1	1,123	0.300	824	0.258	-3.269***
BRD_QL_2	1,123	0.296	824	0.253	-3.545***
BRD_QL_3	1,123	0.280	824	0.237	-3.670***

Panel E: BRD Quality - 2010-2014 vs. 2015-2019					
	2010-2014		2015-2019		
Variables	N	Mean	N	Mean	t-statistic
BRD_QL_1	908	0.296	1,039	0.270	-2.047**
BRD_QL_2	908	0.280	1,039	0.276	-0.402
BRD_QL_3	908	0.262	1,039	0.261	-0.067

This table presents a descriptive analysis of reporting quality according to GRI 304. Column N contains the number of observations. S.D. includes the standard deviation of the variables. Panels B, C, D, and E contain the t-test on the differences in the means of the scores of the reporting quality according to GRI 304 of the sub-samples. Primary industries include sectors such as fishing, mining, and forestry that are directly dependent on ecosystems and have an impact on biodiversity. High Risk includes industries with high biodiversity risk according to F&C Asset Management (2004). Developed regions includes companies that are located in a country that is classified as developed by the United Nations in 2022.

Table V-4: Summary of quantitative measures reported according to GRI 304

Panel A: Area of Operational Sites according to GRI 304-1

Units	N	Mean	S.D.	Q1	Median	Q3
ha	249	125,777.061	370,072.940	83.000	3,025.000	33,283.310
km	32	3,446.338	6,951.487	59.750	325.000	1,155.750
sites	26	215.538	390.824	12.000	52.500	122.000
percent	14	69.357	34.945	28.000	84.000	100.000
piece	9	9.778	13.980	2.000	3.000	8.000
na	1	177,458.400				

Panel B: Area of Habitat Protected according to GRI 304-3

Units	N	Mean	S.D.	Q1	Median	Q3
ha	302	309,460.591	1,996,426.100	91.035	1,272.355	17,442.306
km	10	3,623.710	8,304.499	767.000	1,212.000	1,410.000
piece	5	6.600	0.894	7.000	7.000	7.000
m	2	100,140.000	141,223.366	280.000	100,140.000	200,000.000

Panel C: Number of Threatened Species according to GRI 304-4

Units	N	Mean	S.D.	Q1	Median	Q3
Count	208	177.279	363.249	12.000	50.000	193.000

Panel D: Primary vs. Secondary Industry

	Primary		Secondary		
Variables	N	Mean	N	Mean	t-statistic
Operational Sites (GRI 304-1)	41	77,821.463	183	153,703.870	1.133
Habitat Protected (GRI 304-3)	59	8,456.391	237	392,228.571	1.310
Threatened Species (GRI 304-4)	46	163.239	162	181.265	0.296

Panel E: High Risk vs. Low Risk Industry

	High Risk		Low Risk		
Variables	N	Mean	N	Mean	t-statistic
Operational Sites (GRI 304-1)	162	192,478.671	62	2,208.767	-3.361***
Habitat Protected (GRI 304-3)	221	420,979.920	75	5,607.148	-1.545
Threatened Species (GRI 304-4)	156	181.353	52	165.058	-0.280

Panel F: Developed vs. Developing Regions

	Developed		Developing		
Variables	N	Mean	N	Mean	t-statistic
Operational Sites (GRI 304-1)	164	120,165.904	60	193,521.333	1.256
Habitat Protected (GRI 304-3)	178	96,837.001	118	645,933.155	2.311***
Threatened Species (GRI 304-4)	123	213.293	85	125.165	-1.728*

Panel G: 2010-2014 vs. 2015-2019

	2010-2014		2015-2019		
Variables	N	Mean	N	Mean	t-statistic
Operational Sites (GRI 304-1)	101	88,295.600	123	182,118.965	1.811*
Habitat Protected (GRI 304-3)	121	583,509.942	175	130,585.117	-1.909*
Threatened Species (GRI 304-4)	79	174.241	129	179.140	0.094

This table presents a descriptive analysis of the quantitative measures reported according to GRI 304. Panels A, B, C contain the descriptive for the disclosure items of GRI 304-1, GRI 304-2, and GRI 304-4. The column N contains the number of the observations. S.D. includes the standard deviation of the variables. Q1 and Q3 determine the 25^{th} and 75^{th} percentile. Panels C, D, E, F, and G contain the t-test on the differences in the means of the quantitative measures according to GRI 304 of the sub-samples. Primary industries include companies such as fishing, mining, and forestry that are directly dependent on ecosystems and have an impact on biodiversity. High Risk includes industries with high biodiversity risk according to F&C Asset Management (2004). Developed regions includes companies that are located in a country that is classified as developed by the United Nations in 2022. ***, ** and * indicate significance at the ten, five, and one percent levels, respectively. Variables are defined as in Appendix A.

Table V-5: Effect of climate risk disclosure and climate managerial incentives on biodiversity-related disclosure quality according to GRI 304

VARIABLES	(1) BRD QL_1	(2) BRD QL_2	(3) BRD_QL_3	(4) BRD_QL_1	(5) BRD_QL_2	(6) BRD_QL_3
CDPQ	**0.030***	**0.030***	**0.028***			
	(0.017)	**(0.016)**	**(0.016)**			
BO				**0.041**	**0.034**	**0.033**
				(0.027)	**(0.027)**	**(0.025)**
CR				**0.088*****	**0.089*****	**0.084*****
				(0.029)	**(0.028)**	**(0.027)**
CI				**-0.093*****	**-0.088*****	**-0.084*****
				(0.028)	**(0.027)**	**(0.026)**
SIZE	0.006	0.009	0.009	0.008	0.011	0.011
	(0.026)	(0.025)	(0.024)	(0.025)	(0.025)	(0.023)
LEV	-0.068	-0.069	-0.063	-0.063	-0.063	-0.057
	(0.088)	(0.085)	(0.080)	(0.088)	(0.084)	(0.079)
ROA	-0.171	-0.135	-0.109	-0.134	-0.100	-0.076
	(0.202)	(0.193)	(0.181)	(0.196)	(0.189)	(0.177)
CAPINT	-0.011	-0.010	-0.013	-0.006	-0.005	-0.009
	(0.034)	(0.034)	(0.032)	(0.033)	(0.032)	(0.031)
MTB	0.003	-0.001	-0.002	0.004	0.000	-0.001
	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.011)
D_GDP	-0.006	-0.005	-0.003	-0.005	-0.004	-0.003
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)
INFLATION	0.002	0.002	0.001	0.002	0.002	0.001
	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
CORR	-0.172**	-0.177**	-0.180**	-0.160**	-0.165**	-0.169**
	(0.079)	(0.075)	(0.071)	(0.080)	(0.076)	(0.072)
CO2	-0.023	-0.021	-0.021	-0.026	-0.025	-0.024
	(0.022)	(0.021)	(0.020)	(0.022)	(0.021)	(0.020)
ESG	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	1,676	1,676	1,676	1,676	1,676	1,676
Adj. R-squared	0.369	0.372	0.378	0.378	0.380	0.387
Year FE	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES

This table includes regression coefficients of the model in Eq. (2). Standard errors are presented on parentheses below and clustered on firm level. ***, **, and * indicate significance levels at the ten, five, and one percent level, respectively. Variables are defined as in Appendix A.

Table V-6: Effect of biodiversity disclosure according to GRI 304 and investors' risk perceptions

VARIABLES	(1) DV= COEC BRD = BRD QL 1	(2) DV= COEC BRD = BRD QL 1	(3) DV= COEC BRD = BRD QL 1	(4) DV= COEC BRD = BRD QL 1	(5) DV= COEC BRD = BRD QL 2	(6) DV= COEC BRD = BRD QL 2	(7) DV= COEC BRD = BRD QL 2	(8) DV= COEC BRD = BRD QL 2	(9) DV= COEC BRD = BRD QL 3	(10) DV= COEC BRD = BRD QL 3	(11) DV= COEC BRD = BRD QL 3	(12) DV= COEC BRD = BRD QL 3
BRD	**0.040****	**0.063*****	**0.010**	**-0.027**	**0.039****	**0.055****	**0.017**	**-0.028**	**0.041****	**0.058****	**0.022**	**-0.025**
	(0.019)	**(0.023)**	**(0.082)**	**(0.098)**	**(0.019)**	**(0.025)**	**(0.084)**	**(0.099)**	**(0.020)**	**(0.026)**	**(0.090)**	**(0.106)**
BIO_WORDS	-0.014	-0.028***	-0.015	-0.023**	-0.014	-0.026**	-0.015	-0.020*	-0.013	-0.026**	-0.014	-0.020*
	(0.010)	(0.010)	(0.010)	(0.011)	(0.009)	(0.010)	(0.009)	(0.011)	(0.009)	(0.010)	(0.009)	(0.011)
BRD x BIO_WORDS			0.006	0.018			0.005	0.016			0.004	0.016
			(0.017)	(0.020)			(0.017)	(0.020)			(0.018)	(0.022)
MTB	-0.028***	-0.027***	-0.028***	-0.026***	-0.028***	-0.027***	-0.028***	-0.026***	-0.028***	-0.027***	-0.028***	-0.025***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
SIZE	0.004	0.007	0.004	0.010	0.004	0.008	0.004	0.010	0.004	0.008	0.004	0.010
	(0.015)	(0.017)	(0.015)	(0.018)	(0.015)	(0.016)	(0.015)	(0.018)	(0.015)	(0.016)	(0.015)	(0.018)
ESG	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
INFLATION	0.001	-0.002	0.001	-0.001	0.001	-0.001	0.001	-0.000	0.001	-0.001	0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
D_GDP	-0.003	-0.001	-0.003	-0.003	-0.003	-0.001	-0.003	-0.003	-0.003	-0.001	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
CDPQ	-0.023	-0.017	-0.024	-0.020	-0.023	-0.017	-0.023	-0.019	-0.023	-0.017	-0.023	-0.018
	(0.021)	(0.024)	(0.022)	(0.025)	(0.021)	(0.023)	(0.022)	(0.025)	(0.021)	(0.023)	(0.022)	(0.025)
TOTAL_WORDS	0.009	0.014	0.009	0.007	0.009	0.013	0.009	0.006	0.009	0.013	0.009	0.006
	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)
MGMT_CL	0.005	-0.013	0.004	-0.001	0.004	-0.005	0.003	0.006	0.003	-0.005	0.003	0.006
	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)	(0.013)	(0.011)	(0.010)	(0.011)	(0.013)	(0.011)	(0.010)
Observations	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359
Adj. R-squared	0.346	0.358	0.346	0.342	0.346	0.361	0.346	0.345	0.345	0.361	0.346	0.345
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
BAL		YES		YES		YES		YES		YES		YES

This table reports the regression coefficients of the model in Eq. (3). DV indicates the dependent variable, the next period's implied cost of equity for a given company. BRD indicates the respective variable of interest. BAL indicates regressions including balancing by applying entropy score balancing. Standard errors are presented in parentheses and clustered at the firm level. ***, ** and * indicate significance at the ten, five, and one percent levels, respectively. Variables are defined as in Appendix A.

Table V-7: Effect of biodiversity disclosure according to GRI 304 and firm reputation

VARIABLES	(1) DV = SENT BRD = BRD_QL_1	(2) DV = SENT BRD = BRD_QL_2	(3) DV = SENT BRD = BRD_QL_3	(4) DV = SENT BRD = QUANT
BRD	**0.086****	**0.092****	**0.097****	**0.062*****
	(0.036)	**(0.038)**	**(0.040)**	**(0.019)**
BIO_WORDS	-0.007	-0.008	-0.008	-0.009
	(0.012)	(0.012)	(0.012)	(0.011)
SIZE	-0.039*	-0.039*	-0.038*	-0.036*
	(0.020)	(0.020)	(0.020)	(0.019)
MTB	-0.001	-0.001	-0.001	0.001
	(0.006)	(0.006)	(0.006)	(0.005)
ESG	-0.002	-0.002	-0.002	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
INFLATION	0.002	0.002	0.002	0.003
	(0.007)	(0.007)	(0.007)	(0.007)
D_GDP	-0.001	-0.001	-0.001	0.000
	(0.008)	(0.008)	(0.008)	(0.007)
ID	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	585	585	585	585
Adj. R-squared	0.434	0.435	0.434	0.440
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES

This table reports the regression coefficients of the model in Eq. (3). DV indicates the dependent variable, the next period's sentiment in news articles about environmental and social events for a given company. BRD indicates the respective variable of interest. Standard errors are presented in parentheses and clustered at the firm level. ***, ** and * indicate significance at the ten, five, and one percent levels, respectively. Variables are defined as in Appendix A.

Table V-8: Relationship between disclosure quality according to GRI 304 and impression management

VARIABLES	(1) DV= TONE_BIO BRD= BRD_QL_1	(2) DV= FO_BIO BRD= BRD_QL_1	(3) DV= UN_BIO BRD= BRD_QL_1	(4) DV= TONE_BIO BRD= BRD_QL_2	(5) DV= FO_BIO BRD= BRD_QL_2	(6) DV= UN_BIO BRD= BRD_QL_2	(7) DV= TONE_BIO BRD= BRD_QL_3	(8) DV= FO_BIO BRD= BRD_QL_3	(9) DV= UN_BIO BRD= BRD_QL_3
BRD	**-0.141*** **	**-0.046*** **	**-0.061*** **	**-0.142*** **	**-0.049*** **	**-0.065*** **	**-0.146*** **	**-0.051*** **	**-0.068*** **
	(0.037)	**(0.013)**	**(0.018)**	**(0.038)**	**(0.013)**	**(0.018)**	**(0.041)**	**(0.014)**	**(0.019)**
SIZE	0.013	0.020**	0.004	0.014	0.020**	0.004	0.014	0.020**	0.004
	(0.023)	(0.008)	(0.011)	(0.022)	(0.008)	(0.011)	(0.022)	(0.008)	(0.011)
LEV	-0.118	-0.065**	-0.029	-0.118	-0.066**	-0.029	-0.118	-0.066**	-0.029
	(0.087)	(0.030)	(0.040)	(0.087)	(0.030)	(0.040)	(0.087)	(0.030)	(0.040)
ROA	-0.054	-0.020	0.042	-0.049	-0.018	0.044	-0.045	-0.017	0.045
	(0.232)	(0.092)	(0.126)	(0.233)	(0.092)	(0.127)	(0.233)	(0.091)	(0.126)
CAPINT	0.066**	0.018	0.005	0.066**	0.018	0.005	0.065**	0.018	0.005
	(0.032)	(0.012)	(0.017)	(0.032)	(0.012)	(0.017)	(0.032)	(0.012)	(0.017)
MTB	0.010	0.006	0.000	0.009	0.005	0.000	0.009	0.005	0.000
	(0.014)	(0.005)	(0.007)	(0.014)	(0.005)	(0.007)	(0.014)	(0.005)	(0.007)
D_GDP	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.001	0.001	0.000
	(0.007)	(0.003)	(0.003)	(0.007)	(0.003)	(0.003)	(0.007)	(0.003)	(0.003)
INFLATION	0.011	0.003	0.006**	0.011	0.003	0.006**	0.011	0.003	0.006**
	(0.007)	(0.002)	(0.003)	(0.007)	(0.002)	(0.003)	(0.007)	(0.002)	(0.003)
CORR	-0.062	-0.032	-0.049	-0.063	-0.032	-0.050	-0.064	-0.033	-0.051
	(0.076)	(0.030)	(0.035)	(0.076)	(0.030)	(0.035)	(0.076)	(0.030)	(0.035)
CO2	0.017	0.005	-0.011	0.017	0.005	-0.011	0.017	0.005	-0.011
	(0.022)	(0.008)	(0.009)	(0.022)	(0.008)	(0.009)	(0.022)	(0.008)	(0.009)
ESG	-0.001	-0.000	0.000	-0.001	-0.000	0.000	-0.001	-0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
OVERALL	0.769***	32.815***	30.303***	0.771***	32.812***	30.328***	0.772***	32.843***	30.382***
	(0.071)	(3.217)	(4.412)	(0.071)	(3.216)	(4.411)	(0.071)	(3.213)	(4.397)
TOT_WORDS	0.000***	0.000	-0.000	0.000***	0.000	-0.000	0.000***	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,672	1,672	1,672	1,672	1,672	1,672	1,672	1,672	1,672
Adj. R-squared	0.313	0.252	0.297	0.313	0.252	0.298	0.312	0.252	0.298
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

This table reports the regression coefficients of the model in Eq. (3). DV indicates the dependent variable related to the qualitative disclosure of a company (i.e., tone in biodiversity-related disclosure, use of forward-looking and uncertain phrases in biodiversity-related disclosure. BRD indicates the respective variable of interest. Standard errors are presented in parentheses and clustered at the firm level. OVERALL indicates the respective tone variable in relation to the overall ESG disclosure. ***, ** and * indicate significance at the ten, five, and one percent levels, respectively. Variables are defined as in Appendix A.

7. Appendix

7.1 Appendix A: Variable Definitions

Panel A: Variables used in the analysis of the quantity and quality of biodiversity-related disclosure.

BRD_QL_1	Biodiversity-related disclosure quality according to GRI 304, multiplying the item i with the assigned quality value q divided by a total of 12: $\frac{\sum i \times q}{12}$. (ESG disclosures)
BRD_QL_2	Biodiversity-related disclosure quality according to GRI 304, multiplying the item i with the assigned quality value q, plus a value of one if a company also reports a management approach on biodiversity divided by a total of 13: $\frac{\sum i \times q}{13}$. (ESG disclosures)
BRD_QL_3	Biodiversity-related disclosure quality according to GRI 304, multiplying the item i with the assigned quality value, plus a value of one if a company also reports a management approach on biodiversity divided by, plus a value of one if a company reports on a biodiversity strategy divided by a total of 14: $\frac{\sum i \times q}{14}$. (ESG disclosures)
QUANT	Indicator variable equals one if a company reports some quantitative measures within their biodiversity disclosure, zero otherwise. (ESG disclosures)
PRIME	Indicator equals one if a company belongs to an industry directly depending on and impacting ecosystem services.
HIGH RISK	Indicator equals one if a company belongs to an industry classified by F&C Asset Management (2004) as a high-risk (red zone) company.
DEV	Indicator equals one if a company is headquartered in a country classified by the UN as developed, zero otherwise.

Panel B: Variables for the model testing the determinants of biodiversity disclosure.

SIZE	Natural logarithm of total assets. (Compustat item at)
LEV	Total debt divided by total assets. (Compustat items dlc and dltt)
ROA	Income before taxes divided by total assets. (Compustat item ib)
CAPINT	Property, plant, and equipment divided by total assets. (Compustat item ppegt)
MTB	Market-to-book ratio, calculated as the sum of the market value of equity (number of shares outstanding multiplied with the fiscal year's end stock price) and the book value of debt divided by total assets. (Compustat)
D_GDP	Country level growth of the GDP. (World Bank)
INFLATION	Country level inflation rate. (World Bank)
CORR	Control of corruption index. (World Bank)
CO2	Country level CO2 emissions. (World Bank)
ESG	Environmental pillar score reflecting a company's overall environmental performance. (Refinitiv ESG)
CDPQ	Indicator variable equals one if a company completed the CDP climate questionnaire in the financial year, zero otherwise. (CDP)
BO	Indicator variable equals one if a company stated in the CDP questionnaire that the board is responsible for climate matters, zero otherwise. (CDP)
CR	Indicator variable equals one if a company stated in the CDP questionnaire that they identify material climate-related risks for their business, zero otherwise. (CDP)

Cont. Appendix A: Variable Definitions

CI	Indicator variable equals one if a company stated in the CDP questionnaire that they tie their climate-related performance to executive compensation. (CDP)
Panel C: Variables for the model testing the association between biodiversity disclosure, implied cost of equity capital, and news sentiment.	
COEC	Cost of equity capital following the approach outlined in Hou et al. (2012) We take the average value of all available cost of equity values using actual earnings numbers (model-based forecasts) as estimated with five different cost of equity measures: Claus and Thomas (2001), Gebhardt et al. (2001), Gordon and Gordon (1997), MPEG/Easton (2004), and Ohlson and Juetter-Nauroth (2005). All values converted to USD (Cao et al., 2017). (Compustat)
BIO_WORDS	Natural logarithm of the total amount of biodiversity-related word mentioned in the ESG disclosure according to the wordlist of Adler et al (2018). (ESG disclosures)
TOTAL_WORDS	Natural logarithm of the total number of words mentioned in the ESG disclosure.
MGMT_CL	Indicator variable equals one if a company reports on a strategy for CO2 reduction, zero otherwise. (ESG disclosures)
ID	Sum of articles published concerning a company in connection with an environmental or social event during a business year. (RavenPack)
SENT	Average RavenPack Event Sentiment Score generated based on all press releases and full articles published about a company related to an environmental or social event during a financial year. (RavenPack)
Panel D: Variables employed in the additional investigation of the relationship between characteristics of textual disclosures and the application of GRI 304.	
TONE	Overall tone in the ESG report calculated as the difference between the number of positive and the number of negative words divided by the sum of the number of positive and the number of negative words in a disclosure. The number of positive and negative phrases is collected via Python using the dictionary of Loughran and McDonald (2011).
TONE_BIO	Tone in biodiversity-related sentences calculated as the difference between the number of positive and the number of negative words in sentences including at least one biodiversity-related word divided by the sum of the number of positive and the number of negative words in all sentences including at least one biodiversity-related word. The number of positive and negative phrases is collected via Python using the dictionary of Loughran and McDonald (2011). Conditional sentences are identified by the dictionary provided by Adler et al. (2018).
TONE_CLK	Tone in climate-related sentences calculated as the difference between the number of positive and the number of negative words in sentences including at least one climate-related word divided by the sum of the number of positive and the number of negative words in all sentences including at least one climate-related word. The number of positive and negative phrases is collected via Python using the dictionary of Loughran and McDonald (2011). Conditional sentences are identified by the dictionary provided by Kim et al. (2022)
FO	Overall use of forward-looking phrases in the ESG report calculated as the number of forward-looking phrases divided by the total number of words in the disclosure. Forward-looking phrases are collected via Python using the approach of Bozanic et al. (2018).

Cont. Appendix A: Variable Definitions

FO_BIO	Use of forward-looking phrases in biodiversity-related sentences calculated as the number of forward-looking phrases in sentences including at least one biodiversity-related word scaled by the total number of biodiversity-related words in the respective disclosure. Forward-looking phrases are collected via Python using the approach of Bozanic et al. (2018). Conditional sentences are identified by the dictionary provided by Adler et al. (2018).
FO_CLK	Use of forward-looking phrases in climate-related sentences calculated as the number of forward-looking phrases in sentences including at least one climate-related word scaled by the total number of climate-related words in the respective disclosure. Forward-looking phrases are collected via Python using the approach of Bozanic et al. (2018). Conditional sentences are identified by the dictionary provided by Kim et al. (2022).
UN	Overall use of uncertainty-related phrases in the ESG report calculated as the number of uncertainty-related phrases divided by the total number of words in the disclosure. Uncertainty-related phrases are collected via Python using the dictionary of Loughran and McDonald (2011).
UN_BIO	Use of uncertainty-related phrases in biodiversity-related sentences calculated as the sum of all uncertainty-related phrases in sentences including at least one biodiversity-related word scaled by the total number of biodiversity-related words in the respective disclosure. Uncertainty-related phrases are collected via Python using the dictionary of Loughran and McDonald (2011). Conditional sentences are identified by the dictionary provided by Adler et al. (2018).
UN_CLK	Use of uncertainty-related phrases in climate-related sentences calculated as the sum of all uncertainty-related phrases in sentences including at least one climate-related word scaled by the sum of climate-related words in the respective disclosure. Uncertainty-related phrases are collected via Python using the dictionary of Loughran and McDonald (2011). Conditional sentences are identified by the dictionary provided by Kim et al. (2022)

This table presents variable definitions for the variables included the analysis. We convert all financial numbers to USD at the applicable exchange rate at the end of the respective financial year. Continuous variables that do not reflect a score are winsorized at the 1st and 99th percent level.

7.2 Appendix B: Descriptive Statistics

Panel A: Descriptive statistics of the variables employed in the analysis of the motivations of biodiversity disclosure according to GRI 304.

Variables	N	Mean	S.D.	Q1	Median	Q3
BRD _QL_1	1,676	0.279	0.276	0.000	0.167	0.500
BRD _QL_2	1,676	0.276	0.267	0.000	0.231	0.538
BRD _QL_3	1,676	0.260	0.252	0.000	0.214	0.500
QUANT	1,676	0.282	0.450	0.000	0.000	1.000
CDPQ	1,676	0.659	0.474	0.000	1.000	1.000
BO	1,676	0.709	0.454	0.000	1.000	1.000
CR	1,676	0.733	0.443	0.000	1.000	1.000
CI	1,676	0.684	0.465	0.000	1.000	1.000
SIZE	1,676	9.890	0.676	9.499	10.102	10.489
LEV	1,676	0.273	0.143	0.171	0.260	0.369
ROA	1,676	0.043	0.050	0.018	0.036	0.066
CAPINT	1,676	0.741	0.454	0.385	0.707	1.009
MTB	1,676	1.070	0.853	0.618	0.828	1.201
INFLATION	1,676	1.715	1.994	0.511	1.496	2.111
D_GDP	1,676	2.061	1.795	1.119	1.967	2.777
CORR	1,676	1.228	0.795	0.646	1.480	1.816
CO2	1,676	8.900	4.187	5.498	8.858	11.548
ESG	1,676	73.216	15.951	64.060	76.335	85.425

Panel B: Descriptive statistics of the variables employed in the analysis of the association between investors' risk perceptions and biodiversity disclosure according to GRI 304.

Variables	N	Mean	S.D.	Q1	Median	Q3
BRD_QL_1	1,359	0.259	0.275	0.000	0.167	0.500
BRD_QL_2	1,359	0.255	0.265	0.000	0.154	0.462
BRD_QL_3	1,359	0.240	0.250	0.000	0.143	0.429
COEC	1,359	0.096	0.120	0.044	0.061	0.091
BIO_WORDS	1,359	4.461	0.845	3.892	4.466	5.100
CDPQ	1,359	0.826	0.379	1.000	1.000	1.000
SIZE	1,359	9.803	0.693	9.384	9.926	10.489
MTB	1,359	1.767	1.497	0.856	1.342	2.243
ESG	1,359	69.176	13.450	61.010	69.930	79.450
INFLATION	1,359	1.804	2.202	0.420	1.328	2.261
D_GDP	1,359	2.053	1.959	0.956	1.865	2.850
TOTAL	1,359	10.724	0.647	10.311	10.685	11.072

Panel C: Descriptive statistics of the variables employed in the analysis of the association between news sentiment and biodiversity disclosure according to GRI 304.

Variables	N	Mean	S.D.	Q1	Median	Q3
BRD _QL_1	585	0.308	0.276	0.000	0.333	0.500
BRD _QL_2	585	0.303	0.267	0.000	0.308	0.538
BRD _QL_3	585	0.285	0.253	0.000	0.286	0.500
QUANT	585	0.304	0.460	0.000	0.000	1.000
SENT	585	-0.035	0.163	-0.153	-0.037	0.076
BIO_WORDS	585	10.669	0.637	10.241	10.617	11.057
SIZE	585	9.971	0.626	9.531	10.266	10.489
MTB	585	2.030	1.737	0.937	1.527	2.615
ESG	585	70.740	11.582	63.460	71.250	78.910
INFLATION	585	1.765	1.643	0.920	1.658	2.078
D_GDP	585	2.180	1.832	1.375	2.230	2.870
ID	585	477.723	1,845.479	8.000	32.000	172.000

This table shows descriptive statistics of the variables employed in the analysis of the motivations of biodiversity disclosure according to GRI 304 (Panel A), regarding the perceptions of investors (Panel B), and news sentiment (Panel C). Variables are defined as in Appendix A.

Part VI: Biodiversity Management and Stock Price Crash Risk

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1. Introduction

Biodiversity loss and its consequences are currently recognized as one of the most urgent risks the world is facing (WEF, 2022). Therefore, the objective of this study is to investigate whether financial markets are aware of the biodiversity risks that companies face. In contrast to climate change, which receives significant attention from both investors and the financial research community (Krueger et al., 2020; Stroebel & Wurgler, 2021), biodiversity issues are not an area of importance for corporate reporting (Adler et al., 2018; Adler et al., 2017), firms' financial decisions (Nedopil, 2022), or firms' overall sustainability practices (Schaltegger et al., 2022). This is despite the fact that an estimated 20 percent of the largest publicly traded companies face material risks associated with biodiversity loss and its impacts (Carvalho et al., 2022). Rather, companies that cause significant negative impacts on biodiversity, such as mining, adopt reporting techniques to dilute their negative impacts (Boiral, 2016). Meanwhile, there has been a substantial increase in large publicly traded companies emphasizing their commitment to biodiversity conservation (29 percent of the largest publicly traded companies in 2018), in particular among companies that are more dependent on or have a greater impact on ecosystem services (Carvalho et al., 2022).

The surveys by Krueger et al. (2020) and Stroebel and Wurgler (2021) show that most institutional investors consider climate risks a material risk factor. For instance, climate risks significantly increase a company's credit default swap (CDS) or bond spreads, both measures of an increased company's risk profile (Kölbel et al., 2020; Seltzer et al., 2022). In contrast to climate change risks, biodiversity risks are harder to grasp due to their high complexity (Schaltegger et al., 2022). Efficient corporate environmental management (i.e., strong environmental performance) mitigates corporate risk as perceived by investors and hedges against climate-related risks (El Ghoul et al., 2018; Kim et al., 2014). In analogy, we argue that strong biodiversity management is negatively associated with financial risk.

We hypothesize that, due to distinct features of biodiversity risks, strong biodiversity management affects financial risk perceptions. To our knowledge, there is to date no study that addresses the (non)importance of biodiversity risk and its management as a financial risk factor. Thus, this paper is the first to empirically analyze the relationship between a company's actions on reducing its biodiversity impacts and dependencies (i.e., biodiversity management) and a company's financial risk profile. We capture financial risk by stock price crash risk, a measure frequently applied to assess the risk of substantial negative stock returns (Habib et al., 2018). In a multivariate analysis, we study whether strong biodiversity management is acknowledged

as value-preserving by financial markets and whether it can help reduce a company's risk profile. To measure biodiversity management, we use data from Vigeo Eiris, a data provider that is since 2020 fully integrated into Moody's ESG Solutions. Vigeo Eiris is one of the few data providers to collect yearly data on corporate biodiversity management. Drawing on a global dataset spanning 45 countries and 1,402 listed firms, our results indicate that companies with stronger biodiversity management are at lower risk of significant stock price declines. We use a global dataset because the loss of biodiversity affects companies worldwide. Our results show that the management of biodiversity impacts and dependencies thereon have a major influence on the perception of firms' financial risks, besides overall environmental, social, and governance (ESG) performance. A one standard deviation increase in overall biodiversity management is associated with a decrease of 4.2393 percent and 5.0388 percent, respectively, for our two measures of stock price crash risk. Moreover, we find that stakeholder feedback on firms' biodiversity management is of special importance for firms in need of legitimacy, i.e., those with low overall ESG performance or low profitability.

In an additional analysis, we look at environmental inspections by the US Environmental Protection Agency (EPA), as an exogenous shock to the information environment around the state of a firm's biodiversity management. In a difference-in-differences design, we find that firms that undergo an EPA inspection see a significant increase in their stock price crash risk in the year following the inspection. This underlines that a firm's impact on the state of biodiversity around its operating facilities is a potential financial risk factor. We argue that environmental inspections are one channel through which negative information on companies' biodiversity stewardship is revealed to the public.

The contribution of our study is twofold. First, it enhances our understanding of the importance of environmental risk factors for financial markets besides climate change. While climate change and its consequences are currently getting a lot of attention (Giglio et al., 2021; H. Hong et al., 2020), this study underlines that specific environmental risks should not be limited to this one topic. Prior research so far examines how companies value biodiversity itself (Anthony & Morrison-Saunders, 2022), the extent to which they report on biodiversity (Hassan et al., 2022), their commitment to biodiversity (Silva et al., 2019), and the factors that motivate companies to publish disclosures on biodiversity (Hassan et al., 2020). Moreover, Carvalho et al. (2022) finds that companies exposed to biodiversity-related risks implement policies for biodiversity. Thus, our findings extend these studies on the importance of biodiversity management in financial decision making. By examining the financial consequences of biodiversity management, we open up a new strand in the biodiversity disclosure and management literature,

which has mainly focused on the importance and motives of biodiversity disclosure (Boiral & Heras-Saizarbitoria, 2017a, 2017b).

Second, this study adds to the literature on how non-financial risk factors influence stock price crash risk. Most studies focus only on a subset of industries such as banking or renewable energy (Fiordelisi et al., 2022; Yildiz & Karan, 2020). In contrast, our sample includes a wide range of different industries across multiple countries, all of which have varying relationships and dependencies towards biodiversity. Finally, our study has practical implications for management and investors, as we show that shareholders value the management of biodiversity risks, suggesting that the impacts and dependencies on (intact) ecosystems are a risk factor to consider. Thus, companies should allocate sufficient resources to managing biodiversity risks to prevent declines in share price.

The remainder of the paper is structured as follows. The next section (Section 2) reviews prior literature and develops our hypotheses. Section 3 presents our methodology and the sample selection procedure. We provide and discuss the results in Section 4. Section 5 displays additional results and robustness checks. Section 6 concludes.

2. Hypotheses Development

2.1 Biodiversity Loss and Firm Level Risk

Studies by Dasgupta (2021) and Carvalho et al. (2022) show that the loss of biodiversity poses a significant risk for many companies. Up to now, empirical financial research has not examined the importance of biodiversity (loss) for corporations and whether it is a possible financial risk factor on a firm level. A few studies point out the great variety with which companies report on biodiversity issues (Adler et al., 2018; Adler et al., 2017; Anthony & Morrison-Saunders, 2022), underlining that the attitude of companies towards biodiversity is heterogeneous. These findings are supported by the survey results of Wagner (2022), which suggest that the majority of corporate actions toward safeguarding biodiversity are of symbolic value. Contrary to climate change, biodiversity impacts, dependencies, and actions are harder to grasp and evaluate in corporate reporting due to their high complexity (Schaltegger et al., 2022). Hence, there is no unifying variable to measure and manage related risks, such as CO_2 emissions (Kennedy et al., 2022), neither any clear thresholds for intactness (Addison et al., 2020).

Nature-related risks, such as the those arising from biodiversity loss, are distinct from the non-financial risk factors analyzed by prior literature. Most importantly, nature-related risks

depict salient yet large-scale issues. In his assessment of the economics of biodiversity, Dasgupta (2021) defines three nature-related financial risks: physical risks, transition risks, and litigation risks. Firms may be exposed to one, two, or all three. On the one hand, many firms are dependent on various types of ecosystem services.[153] For instance, chemical or energy firms may require functioning rivers for cooling their operations, while agricultural firms rely on insects such as bees for crop pollination (*physical risks*). On the other hand, firms put pressure on biodiversity through their business operations. For example, mining firms may need to destroy a once thriving area (in terms of biodiversity) to extract resources. Firms could thus be under pressure from civil society or regulatory authorities, i.e., through litigation (*litigation risk*) or emerging regulation (*transition risks*). This could have various negative consequences, such as threatening a firm's reputation, putting the firm at risk of having to compensate for damage caused, or even jeopardizing the current business model through legislation. These three types of risk all have distinct negative consequences for a firm's financial position and could lead to an unexpected decline in shareholder value. They can thus be considered a financial risk for many companies.

2.2 Stock Price Crash Risk and Biodiversity Management

A multitude of studies analyze factors that influence a firm's stock price crash risk, such as tax avoidance (Kim et al., 2011), religion (Callen & Fang, 2015), or CEO age (Andreou et al., 2017). Chen et al. (2001) conduct the first empirical analysis and find that certain firms, i.e. those who see an increase in trading volume in their common stock, are more likely to experience a stock price crash. Besides financial variables influencing a firm's stock price crash risk, non-financial topics are of increasing importance for companies. In their analysis, Kim et al. (2014) find that a firm's ESG performance mitigates stock price crash risk. They attribute this finding to less bad news hoarding by firms with strong ESG performance. Recently, other non-financial risk factors have been examined regarding their influence on stock price crash risk. Yildiz and Karan (2020) find that a country's overall culture towards environmental issues is a predictor of stock price crash risk. The study by Minnick et al. (2022) shows that carbon risk, measured by a firm's total CO_2 emissions, drives a firm's stock price crash risk. This relationship is attenuated by factors such as the quality of governance or the presence of institutional investors. Yet non-financial performance is a wide field that goes far beyond climate change risks (measured by CO_2 emissions). In addition, aggregated sustainability performance may not

[153] IBPES (2022) defines ecosystem services as "the benefits people obtain from ecosystems."

be able to capture all subtopics of potential importance for financial markets. One further factor to consider is a company's actions around safeguarding biodiversity.

Corporations that focus on managing their impacts and dependencies on biodiversity indicate that they value intact ecosystems and biodiversity. It signals that they are actively managing the pressures their operations present to biodiversity as well as mitigating their dependency on well-functioning ecosystems. These firms intend to reduce their biodiversity risks and thus, we assume, their stock price crash risk. This hypothesis is in line with Christensen (2016), who finds that firms can mitigate the negative fallout of non-financial misconduct through disclosure of their ESG activities. Considering the previous literature on stock price crash risk and the distinct properties of biodiversity risks, we posit that stronger biodiversity management decreases stock price crash risk. Hence, we state our first research hypothesis as follows:

Hypothesis 1 (H1). Strong biodiversity management negatively influences a firm's stock price crash risk.

2.3 Stakeholder Response to Biodiversity Management and Legitimacy

While overall biodiversity management directly reduces a firm's risk profile, the response by stakeholders to a firms' management and actions towards biodiversity may be of additional importance to form their exposure of risk (i.e., stock price crash risk). Chiu and Sharfman (2011) show that the visibility of corporate actions to stakeholders is a channel through which firms' legitimacy is influenced. One key reason why companies engage in ESG activities is to gain and retain legitimacy. In turn, increased legitimacy has positive financial consequences (Chiu & Sharfman, 2011; Kölbel et al., 2020). If firms fall short on their overall ESG performance, they could opt for other ways to enhance their legitimacy. In such cases, positive stakeholder feedback on biodiversity management and actions could provide a fallback option for those companies. Thus, we hypothesize that stakeholder feedback in response to biodiversity management and activities influences a firm's legitimacy and hereby its financial risk (i.e., stock price crash risk). Yet, as biodiversity is only gradually gaining the attention of companies and investors (Adler et al., 2018), we hypothesize that stakeholder feedback to biodiversity management and activities is not of general importance, only for those firms which lack legitimacy in other dimensions (i.e., with low overall ESG performance). Thus, we state our second research hypothesis as follows:

Hypothesis 2 (H2). Stakeholder feedback on biodiversity management negatively influences stock price crash risk only for companies that have a need for legitimacy.

3. Methodology

3.1 Measuring Stock Price Crash Risk

To calculate measures of stock price crash risk, we follow Kim et al. (2021) and start by estimating the following regression to estimate firm-specific weekly stock returns:

$$r_{i,\tau} = \alpha_i + \beta_1 r_{m,\tau-2} + \beta_2 r_{m,\tau-1} + \beta_3 r_{m,\tau} + \beta_4 r_{m,\tau+1} + \beta_5 r_{m,\tau+2} + \epsilon_{i,\tau}, \quad (1)$$

where $r_{i,\tau}$ depicts the return for firm i during week τ. $r_{m,\tau}$ depicts the market return for week τ. Moreover, we include the market returns two weeks around each week to control for nonsynchronous trading (Dimson, 1979; Kim et al., 2021), using the country specific MSCI index return as a proxy for local market returns. We then define a firm's weekly stock return $W_{i,\tau}$, calculated as the natural logarithm of one plus the residual from Eq. (1). Following the comprehensive literature on stock price crash risk (Hasan et al., 2021; Hong et al., 2017; Kim et al., 2021), we use two measures for crash risk. The first, $NCSKEW$, is negative conditional return skewness, whereas the second, $DUVOL$, captures down to up volatility. $NCSKEW$, first introduced by Chen et al. (2001), is calculated using the negative third moment of a firm's weekly returns during a year and dividing that by the standard deviation of weekly returns, raised to the third power. We define $NCSKEW$ in Eq. (2). $DUVOL$ states asymmetric volatilities by dividing the sum of a firm's squared weekly stock return $W_{i,\tau}$ in down weeks by the sum of all squared weekly returns in up weeks, as defined in Eq. (3). Following Chen et al. (2001), we define up (down) weeks as those in which the return is greater (smaller) than a firm's average weekly return in the corresponding year. n_u and n_d, respectively, depict the number of up and down weeks within a firm-year. For both variables, higher values indicate a higher risk of a stock price crash.

$$NCSKEW_{i,t} = -\frac{n(n-1)^{3/2} \sum W_{i,t}^3}{(n-1)(n-2)(\sum W_{i,t}^2)^{3/2}} \quad (2)$$

$$DUVOL_{i,t} = \ln\left[\frac{(n_u - 1)\sum_{DOWN} W_{i,t}^2}{(n_d - 1)\sum_{UP} W_{i,t}^2}\right] \quad (3)$$

3.2 Empirical Model

We deploy the following regression to test our main hypothesis on the relationship between stock price crash risk and a firm's biodiversity management:

$$CRASH_{i,t} = \alpha + \beta_1 BIODIV_{i,t-1} + \sum_{k=2}^{K} \beta_k \, CONTROLS_{k,i,t-1} + \sum_{c=1}^{C} \tau_c \, Country_{c,i} + \sum_{j=1}^{J} \tau_j \, Industry_{j,i} + \sum_{t=1}^{T} \psi_t \, Year_t + \epsilon_{i,t}, \quad (4)$$

where $CRASH_{i,t}$ depicts one of the two measures of stock price crash risk, $NCSKEW_{j,t}$ or $DUVOL_{j,t}$. $Biodiversity_{i,t-1}$ depicts our main variable of interest, indicating a firm's overall biodiversity management in the previous year. The overall biodiversity management variable is calculated by averaging all three biodiversity subscores provided by Vigeo Eiris. We use the subscores as further variables of interest. First, *Biodiv. Leadership* proxies a firm's overall commitment towards preserving biodiversity indicating for example the existence of clear policies related to the topic and the public visibility thereof. Second, *Biodiv. Implementation* indicates the state of overall implementation of said commitment. The pillar assesses the means allocated to achieving the commitment and the scope of implementation in both geographical and operating segments. Finally, *Biodiv. Results* evaluates the results of a firm's ambitions, looking at stakeholder feedback or biodiversity measures. Each of the three biodiversity scores ranges between 0 and 100, with higher values indicating stronger performance. See the studies by Bilbao-Terol et al. (2019) and Cavaco et al. (2020) for a more detailed description of the three-pillar structure established by Vigeo Eiris.

Additionally, we follow Kim et al. (2021) and include several control variables that the prior literature identifies to be determinants of stock price crash risk. We include the lagged negative skewness of stock returns (*LAGNCSKEW*), detrended trading volume (*DTURNOVER*), average weekly returns *(RET)*, and the standard deviation of weekly returns (*SIGMA*). Furthermore, we include several control variables based on company fundamentals. These are firm size (*SIZE*), market to book ratio (*MB*), leverage (*LEV*), and return on assets (*ROA*). We follow the approach by Hong et al. (2017) to control for opaqueness (*OPAQUE*). We retrieve all data for stock prices as well as control variables from Refinitiv Datastream. As our sample consists of a global sample of companies from different countries, we convert all currency amounts into USD. As a final control variable, we include a firm's ESG performance (*ESG*) using Refinitiv ESG data to ensure that the biodiversity variable is not merely a proxy for a firm's overall ESG performance, which Kim et al. (2014) find to be another determinant of stock price crash risk.

We winsorize all control variables at the top and bottom 1 percent level to reduce the possible impact of outliers.[154] Further, we include country and industry fixed effects to control for time invariant specific factors. We include year fixed effects to account for temporal events. See Table VI-1 for a detailed overview of the variables included in our analysis.

3.3 Sample Selection and Descriptive Statistics

Our sample starts with all companies covered by the Vigeo Eiris biodiversity score worldwide. Vigeo Eiris is one of the few providers of firm-level biodiversity information.[155] Due to a strong uptake in firms with available data on biodiversity management, we start our sample period in 2009. Overall, our sample covers a period of 13 years, ending in 2021. We begin with a total of 12,483 observations from 2,230 unique companies. After excluding companies with missing stock price data, missing controls, and ESG variables, the sample includes 7,161 observations from 1,402 companies across 45 different countries. Table VI-2 provides detailed steps of the sample selection procedure.

Table VI-3 gives an overview of the distribution of companies across industries (Panel A) and countries (Panel B) included in our sample. Around 18 percent (257 firms) of the companies included in our sample are headquartered in the US, followed by Australia and the United Kingdom with both around 8 percent (115 and 114 firms, respectively). Other countries with a large number of companies are Canada (108 firms), Japan (81 firms), and Hong Kong (64 firms).

Tables VI-4 and VI-5, respectively, display the summary statistics and pairwise correlation coefficients of the variables used in the baseline analysis. The control variables are generally of similar size and standard deviation compared to other studies on stock price crash risk (Kim et al., 2021; Kim et al., 2014). Our size variable is larger than in other studies analyzing factors influencing stock price crash risk, with a mean market capitalization of USD 6.7 billion. We attribute this to our measure for biodiversity management only being available for large companies. This is in line with other studies employing ESG data (Yildiz & Karan, 2020), as data providers of ESG data frequently focus their attention toward companies with large market capitalization. The average firm shows a market-to-book ratio of 1.82 and a return on assets of 4.16 percent. The correlation coefficients between our different (sub)scores of biodiversity

[154] In untabulated analysis, we find that the results are qualitatively similar if we do not winsorize our control variables.

[155] Vigeo Eiris has been providing ESG research, data and ratings since the 1990s. In 2019, Moody's acquired a majority stake in this company, which officially became part of Moody's ESG Solutions in 2020.

management are, except for the variable measuring the stakeholder response to biodiversity actions (*Biodiversity Results*), highly correlated with correlation coefficients ranging between 0.64 and 0.88 and statistically significant at the 5 percent level.

4. Results

4.1 Biodiversity Management and Stock Price Crash Risk

Tables VI-6 and VI-7 depict the regression results of Eq. (4) for the two measurements of stock price crash risk (i.e., *DUVOL* and *NCSKEW*). For all our regressions, we report clustered standard errors by firm-level in parentheses below each coefficient. Column 1 in Table VI-6 (Table VI-7) indicates that overall strong biodiversity management is related to a lower stock price crash risk with a coefficient of −0.0017 for *DUVOL* (−0.0027 for *NCSKEW*), statistically significant at the 1 percent level. Both effects are statistically and economically significant. On average, a one standard deviation increase in overall biodiversity management is associated with a decrease of 4.2393 percent in *DUVOL* in the following year.[156] The effect size for *NCSKEW* is of similar magnitude (−5.0388 percent). These results suggest an economically significant negative relationship between biodiversity management and stock price crash risk, supporting our Hypothesis 1. The coefficients of our control variables are in line with other studies in terms of sign and magnitude (Chen et al., 2017; Kim et al., 2021; Kim et al., 2014). Firms that show higher past returns, greater size, and exhibit a higher return on assets are subject to a higher stock price crash risk.

Columns 2 to column 4 in Table VI-6 (Table VI-7) show the results for each of the three subscores of biodiversity management separately. The coefficients on the two subscores indicating *Biodiv. Leadership* and *Biodiv. Implementation* are of the same sign and similar magnitude as the overall biodiversity management variable and are at least statistically significant at the 5 percent level. Interestingly, the coefficient for the *Biodiv. Results* variable, capturing the response of stakeholders, shows no statistical significance at frequently used levels. This provides initial evidence for our Hypothesis 2, indicating that positive stakeholder feedback does not result in a general reduction in stock price crash risk.

[156] For *Biodiversity*, we obtain the effect size as follows: $\frac{\beta_{Biodiversity} * SD_{Biodiversity}}{SD_{DUVOL}}$, hence: $\frac{-0.0017 * 19.3809}{0.7772} = -4.2393$ percent.

4.2 Stakeholder Response to Biodiversity Management and Legitimacy

To test the conditioned relationship between *Biodiv. Results* and stock price crash risk, we turn to an analysis using interaction terms. We calculate interaction terms between the *Biodiv. Results* variable and a set of variables capturing a company's requirement to establish legitimacy. We consider three different dimensions that may have an impact on the need for organizations to establish or maintain their legitimacy. First, if they have weak biodiversity management and implementation, Second, if they have overall weak ESG performance. Third, if they exhibit poor financial performance. Hence, we first include the two other subscores for biodiversity as moderators, as good performance regarding *Biodiv. Results* (i.e., positive stakeholder feedback) may only be of importance for a subgroup of firms (i.e., those with low implementation of their actions towards biodiversity). To capture overall ESG performance, we include the overall ESG score. In the case of weak overall ESG performance, stakeholder feedback for certain topics (e.g., biodiversity) may gain importance. The same applies to financial performance, which we capture with a proxy for profitability, namely return on assets.

For the analysis, we calculate the interactions between *Biodiv. Results* and a set of dummy variables. The dummy variable (i.e., *Low Biodiv. Leadership*) is equal to one if the value for the variable (i.e., *Biodiv. Leadership*) is smaller than the corresponding sample median, zero otherwise.[157] We use this approach for all interaction terms accordingly.

Table VI-8, columns 1 to 4 regress our two measures of stock price crash risk on interaction terms between *Biodiv. Results* and dummy variables derived from the two other subscores of biodiversity management. None of the four interaction terms is statistically significant at the 10 percent level or lower, indicating that stakeholder feedback is not more important for firms with low biodiversity management (implementation). Columns 5 and 6 (7 and 8) show that the interaction terms between *Biodiv. Results* and *ROA* (*ESG*) are negative and statistically significant at the 10 percent (5 percent) level. This indicates that strong performance regarding *Biodiv. Results* (i.e., good stakeholder feedback) is of special importance to the financial risk position of firms with low financial (ESG) performance. Firms with low ESG performance may derive a high marginal utility from good biodiversity management as they do not benefit from the risk-reducing effects of strong ESG performance (Godfrey et al., 2009; Kim et al., 2014). Similarly, firms with low financial performance (i.e., low return on assets) may focus on strong management of biodiversity to gain or maintain their legitimacy. Overall, the results provide support for our Hypothesis 2.

[157] Again, note that the results remain qualitatively unchanged if we form the two groups based on yearly median values (untabulated).

5. Additional Analysis

5.1 Environmental Inspections and Stock Price Crash Risk

Building on the above results indicating that biodiversity management reduces the risk of sudden stock price declines, we attempt to establish a causal relationship in this section. Following agency theory (Jensen & Meckling, 1976), the majority of studies on stock price crash risk attribute the occurrence of a sudden drop in share price primarily to bad news hoarding as a consequence of failure of corporate governance mechanisms (Hutton et al., 2009). These failures lead to an asymmetric information environment between management and outside stakeholders. In such a case, managers may withhold negative information through reduced transparency for personal benefits, such as empire building or higher compensation (Ball, 2009; Graham et al., 2005). Negative information is stockpiled and eventually released all at once when management is no longer able to withhold it (Kim et al., 2021). This revelation of bad news then triggers a sudden decline in share price, causing a stock price crash. Emerging areas of importance for companies, such as ESG issues, are a particular area of high information asymmetry, as they frequently do not yet have established and standardized disclosure practices (Schiemann & Sakhel, 2019). Particularly, corporate reporting on biodiversity issues is one of these emerging topics. Several studies analyze firms' disclosure and find that even the world's largest companies or those operating in industries with high impacts or dependencies on biodiversity, such as mining, only provide limited information on biodiversity risks (Adler et al., 2018; Boiral, 2016; Hassan et al., 2020; Rimmel & Jonäll, 2013). Due to pronounced information asymmetry between managers and outside stakeholders, this opaque environment is well suited for hoarding negative information related to biodiversity and ecosystem services.

Besides transparency towards these issues, such as through strong biodiversity management, one possible factor attenuating the extent of information asymmetry is the existence of functioning internal and external control mechanisms. Prior studies show that internal and external controls have distinct influence on the information environment and subsequent stock price crash risk (Chen et al., 2017; Kim et al., 2020; Kim et al., 2011). Especially inspections carried out by governmental agencies could detect the existence of bad information within a company (Zhang et al., 2021), leading to a subsequent release of this news and a corresponding reaction from shareholders.

In consequence, we analyze whether environmental inspections of corporate facilities are one of the channels through which stockpiled bad news is uncovered and subsequently made public. For the analysis, we focus on firms within the US as we require data from the EPA. The

EPA is a federal agency whose responsibilities include monitoring the compliance of potentially polluting facilities across the US. The EPA publishes extensive data on these polluting facilities and whether it conducted an inspection.[158] Additionally, we keep Canadian firms, as many of them operate facilities in the neighboring US. Overall, the EPA lists 62,048 facilities with a valid identifier of which the majority (41,426) were at least once subject to an inspection. It is noteworthy that the EPA only publishes the date of the most recent inspection for each facility.[159] Thus, it is not possible to identify whether a facility was subject to a prior inspection. To mitigate this shortcoming, we aggregate the data on a firm level and use the earliest year any facility of one of the sample companies underwent an EPA inspection as treatment for the release of negative information on biodiversity management to the stock market. Moreover, the omission of inspections prior to the most recent inspections on a facility level only works against us finding any results as negative biodiversity information may have been revealed through the earlier inspection, reducing the effect of the latter. As only a small subset of facilities is inspected by the EPA each year, inspections come as a surprise for investors. Thus, we use the event of an environmental inspection as a quasi-natural experiment where some of our sample companies receive a treatment. Overall, the sample for the difference-in-differences analysis includes 1,701 observations and 365 unique firms which underwent a total of 704 inspections between 2010 and 2021. While our dataset for the baseline analysis starts in 2009, we only consider inspections starting in 2010 as we require one prior year without any inspection for propensity score matching. As only a minority of firms underwent an inspection (we identify a total of 57 companies as treated firms), we use a propensity score matching approach to create a balanced sample of treatment and control firms. We match treatment and control firms using a logit model with a binary variable equal to one for treated firms and equal to zero for control firms as the dependent variable and a firm's leverage and past stock returns as an independent variable to find the closest match in terms of financial health. We use data one year prior to the first inspection year for the matching approach (Caliendo & Kopeinig, 2008). After matching each treated firm to a corresponding control firm, we use a three-year period around each treatment (i.e., first time inspection) to analyze the effect of EPA inspections on stock price crash risk. Due to data restrictions for either treated or control firms, the difference-in-differences sample includes 301 observations (instead of the expected 342).

[158] See the study by Kim (2015) who uses EPA inspections in their study for a detailed description of the EPA processes.

[159] For more information on the EPA's inspection guidelines and procedures, see https://www.epa.gov/enforcement/federal-facilities-inspections-guide-epas-access-and-inspection-authorities.

Table VI-9 depicts the sample means for the difference-in-differences sample split across the assignment to treatment or control group one year prior to each treatment. As indicated by the results of a t-test in the outright column, the majority of means of the control variables do not differ across the two groups, which indicates a good fit for our matching approach.

The variable of interest in a difference-in-differences regression is the interaction term *Treat∗Post*, which is equal to one for treated firms in the years subsequent to the treatment (in this case, the first EPA inspection), and zero for all other observations. Table VI-10 contains the results of the difference-in-differences regression on the two measurements of stock price crash risk. We include all control variables used in our main analysis.[160] As expected, the interaction term is positive and statistically significant, indicating that EPA inspections increase a firm's stock price crash risk, likely through the revelation of negative information on a firm's biodiversity activities.

5.2 Industry-Level Risk

The fallout of biodiversity loss and lapse of ecosystem services is not evenly distributed across industries. Primary industries, i.e., those which directly rely on natural resources as input for their production processes, are much more at risk than secondary industries with less direct overlap with nature (Carvalho et al., 2022; Wagner, 2022). We thus turn to an analysis where we differentiate firms by their exposure to biodiversity risks by following the approach of Rimmel and Jonäll (2013) and Adler et al. (2018). Both studies rely on the classification approach by F&C Asset Management (2004) into industries with red (high), amber (medium), and green (low) risks regarding biodiversity. We assign a dummy variable a value of one if a company is considered active in a red industry.[161] Overall, around 62 percent (4,446) companies are operating in industries with high biodiversity risks. Table VI-11 presents the results. The interaction terms on the overall measure of biodiversity management are only statistically significant for the *DUVOL* measure. Thus, the results only show weak indication of biodiversity management being of greater importance for the financial risk of companies operating in high-risk industries.

[160] Note that we do not include country fixed effects as the sample for the difference-in-differences design only includes companies from two countries. The results remain unchanged if we include country fixed effects for the analysis.

[161] Note that F&C Asset Management (2004) uses the FTSE industry classification, whereas we use the industry classification provided by Vigeo Eiris, see Panel B of Table VI-3. Specifically, we set the dummy variable for a company equal to one if it is active in one of the following industries: Heavy Construction, Electric & Gas Utilities, Food, Forest Products & Paper, Hotel, Leisure Goods & Services, Mining & Metals, Oil Equipment & Services, Waste & Water Utilities, Energy.

Only the interaction term derived from *Biodiv. Implementation* and the dummy variable indicating high risk industries seem to positively influence a firm's stock price crash risk across our two measures of stock price crash risk. This indicates that the risk-reducing effect of strong *Biodiv. Implementation* is less pronounced for firms operating in high-risk industries.

5.3 Robustness Tests

In this section, we perform a battery of robustness tests (untabulated; tables available on request) to provide further support to our results. Table VI-5 shows high correlation coefficients between our control variable capturing overall ESG performance and our measures for biodiversity management. Correlation ranges between 0.51 for the overall measure of biodiversity management and 0.50 (0.48) for the variable indicating biodiversity leadership (implementation). To rule out that this correlation influences our findings, we rerun our regressions without controlling for overall ESG performance. Our results show that the coefficients for our variables of interest remain unchanged in terms of magnitude and statistical significance, giving further support to Hypothesis 1.[162]

Second, we tackle the concern that overall biodiversity management may simply be a proxy for (i.e., highly correlated to) a company's overall disclosure quality or its awareness toward emerging ESG issues. As the issue of biodiversity loss is currently not of importance for many companies, firms with strong biodiversity management could simply be those that show high awareness of overall ESG issues and potentially drive our results. To alleviate this concern, we add a further control variable for companies' awareness of ESG issues. Using data from Refinitiv, we retrieve information on whether companies have policies in place to address ESG issues. Overall, we collect information on 17 different ESG topics.[163] From this data, we construct a variable depicting the share of 17 potential sustainability policies a firm has in place (i.e., if a company has policies for all 17 topics the variable is equal to 1, if the company has no policies in place the variable is equal to 0). We lose 293 observations compared to the baseline sample for which Refinitiv does not provide information on ESG policies. We add the variable

[162] The only two submetrics related to biodiversity included the calculation of the Refinitiv ESG score are the items ENERDP019 and ENPIO10V. Both are yes/no questions and only contribute to the overall ESG score to a very limited extent.

[163] Following the classification of ESG topics by Christensen (2016), we collect the following variables (Refinitiv codes in brackets): Society (SOCODP0067, SOCODP0066, SOCODP0069), product responsibility (SOPRDP0121, SOPRDP0124, SOPRDP0126, SOPRDP0128), labor (SODODP0081, SOHSD01V, SOTDD01V), human rights (SOHRD01V), environment (ENERDP0051, ENRRD01V, ENRRDP0121, ENRRDP0122, ENRRDP0124, ENRRDP0125).

as an additional control to our baseline regression and find that our results remain unchanged. This further strengthens our results as it provides evidence that our variable on biodiversity management does not merely measure a company's overall awareness of emerging ESG issues.

6. Conclusion

The economic value of ecosystem services provided by an intact biodiversity is undisputed on a societal level (Dasgupta, 2021). Capturing perceived financial risk by stock price crash risk, this paper looks at the importance of biodiversity management on a firm level. We construct a global sample of listed companies and find that strong biodiversity management decreases the risk of a stock price crash. In our analysis, we control for a multitude of different variables which prior literature finds to be determinants of crash risk and deploy several robustness checks to strengthen our findings. Thereafter, we use interaction analysis to test for which set of companies' stakeholder feedback toward biodiversity management and actions is of importance. We find that those firms that have a need to build and maintain legitimacy, i.e., those with low overall ESG performance and low profitability, undergo a decrease in their stock price crash risk thanks to better stakeholder feedback on their biodiversity management and activities.

One step further, we use environmental inspections by the EPA as quasi-natural experiments which, we hypothesize, serve as a channel for revealing negative information on biodiversity management practices. A difference-in-differences regression on a propensity score matched sample shows which firms which are subject to an EPA inspection see an increase in their stock price crash risk. The results suggest a causal effect of biodiversity management on stock price crash risk, further supporting our main results.

Our paper contributes to our understanding of how non-financial risk factors influence companies' financial risks, adding to studies by Y. Kim et al. (2014) and Zhang et al. (2021). Moreover, our results guide corporate management by showing the importance of allocating sufficient resources towards biodiversity-preserving actions to reduce a firm's financial risk profile. Companies should proactively approach emerging issues to avoid any negative financial consequences of abstaining from action.

This paper has several limitations. Most importantly, we are not able to apply firm fixed effects due to a low variation of our variables of interest within firms. Incorporating firm fixed effects would capture time invariant firm characteristics and provide further support to our results. The median (mean) standard deviation of our *Biodiversity* variable within firms is equal to 5.8189 (6.4733), which is substantially lower than the standard deviation across our whole sample. The low standard deviation indicates that biodiversity management is rather consistent

across time on a firm level. However, we use a high number of control variables in addition to industry and year fixed effects to alleviate this concern as much as possible. One further caveat is that we rely on third-party data to measure biodiversity management. The factors influencing biodiversity degradation and how companies put pressure on local and global biodiversity are inherently complex and difficult to measure (Schaltegger et al., 2022). High complexity is put up as one reason why companies' responses to the loss in biodiversity has thus far been considered heterogeneous and often only of symbolic value. With no good indicator to measure a company's impact on biodiversity (compared to CO_2 emissions in the case of climate change), all existing variables are proxies at best. Future studies could use other indicators for corporate biodiversity management and the outcome thereof or develop new measurements themselves.

7. References

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Table VI-1: Variable description

VARIABLES	Definition
$\text{Biodiversity}_{i,t}$	Overall biodiversity management score, measured by the Vigeo Eiris ENV1.4 score.
$\text{Biodiv. Leadership}_{i,t}$	Score on biodiversity leadership, measured by the corresponding Vigeo Eiris ENV1.4 subscore.
$\text{Biodiv. Implementation}_{i,t}$	Performance regarding the implementation of measures aimed at the protection of biodiversity, measured by the corresponding Vigeo Eiris ENV1.4 subscore.
$\text{Biodiv. Results}_{i,t}$	Performance regarding stakeholder feedback related to biodiversity management, measured by the corresponding Vigeo Eiris ENV1.4 subscore.
$\text{DUOVOL}_{\text{i,t}}$	Negative conditional firm-specific weekly return skewness, defined as in Eq. (3).
$\text{NCSKEW}_{i,t}$	Down to up volatility of firm-specific weekly returns, defined as in Eq. (2).
$\text{LAGNCSKEW}_{i,t}$	Lagged value of NCSKEW.
$\text{SIGMA}_{i,t}$	Weekly return volatility, calculated as the standard deviation of weekly returns over the year.
$\text{RET}_{i,t}$	Weekly return, measured as the yearly mean of firm-specific weekly returns.
$\text{DTUNROVER}_{i,t}$	Change in monthly turnover, defined as the difference of average monthly share turnover between the current year and the previous year. Monthly share turnover is defined as the monthly trading volume divided by the total number of shares outstanding.
$\text{SIZE}_{i,t}$	Natural logarithm of market value of equity for firm *i* in year *t*.
$\text{MB}_{i,t}$	Market to book ratio, measured as the market value of equity divided by the book value of equity.
$\text{LEV}_{i,t}$	Leverage, defined as the total long-term debts divided by total assets.
$\text{ROA}_{i,t}$	Return on assets, defined as the income before extraordinary items divided by lagged total assets.
$\text{OPAQE}_{i,t}$	Firm opaqueness, measured as the prior three years' moving sum of the absolute value of discretionary accruals estimated by the model from Hutton et al. (2009).
$\text{ESG}_{i,t}$	The total Thomson Reuters ESG Refinitiv score for firm *i* in year *t*.

This table reports descriptions of the variables used in my analysis. The control variables are defined following Kim et al. (2021). The subscripts i and t indicate firm- and year-specific variables.

Table VI-2: Sample selection

		Number of	
		Observations	Firms
	Biodiversity data	12,483	2,230
-	missing stock price data	142	14
-	missing control data	4,754	696
-	missing ESG data	426	118
=	Sample for baseline analysis	7,161	1,402
-	firms outside North America	5,740	1,037
=	Sample for difference-in-differences analysis	1,691	365

This table reports our sample selection procedure. We start with the whole universe for which Vigeo Eiris provides data on biodiversity management. Our sample period spans the period from 2009 to 2021.

Table VI-3: Sector and country distribution of companies included in the analysis

PANEL A: Sector distribution

Generic Sector	No.	%	Generic Sector	No.	%
Electric & Gas Utilities	189	13.48%	Building Materials	49	3.50%
Mining & Metals	147	10.49%	Financial Services - Real Estate	49	3.50%
Food	134	9.56%	Forest Products & Paper	37	2.64%
Pharmaceuticals & Biotechnology	134	9.56%	Industrial Goods & Services	35	2.50%
Energy	124	8.84%	Luxury Goods & Cosmetics	34	2.43%
Specialized Retail	112	7.99%	Chemicals	25	1.78%
Hotel, Leisure Goods & Services	70	4.99%	Waste & Water Utilities	17	1.21%
Supermarkets	57	4.07%	Tobacco	15	1.07%
Beverage	54	3.85%	Health Care Equipment & Services	11	0.78%
Heavy Construction	54	3.85%	Travel & Tourism	1	0.07%
Oil Equipment & Services	54	3.85%	Total	1,402	100.00%

PANEL B: Country distribution

Country	No.	%	Country	No.	%
United States of America	257	18.33%	Malaysia	19	1.36%
Australia	115	8.20%	Sweden	19	1.36%
United Kingdom	114	8.13%	Mexico	18	1.28%
Canada	108	7.70%	New Zealand	16	1.14%
Japan	81	5.78%	Chile	15	1.07%
Hong Kong	64	4.56%	Indonesia	15	1.07%
China	48	3.42%	Norway	15	1.07%
South Korea	48	3.42%	Russia	15	1.07%
France	45	3.21%	Belgium	14	1.00%
India	38	2.71%	Denmark	13	0.93%
Italy	32	2.28%	Finland	13	0.93%
Brazil	31	2.21%	Peru	13	0.93%
Germany	31	2.21%	Poland	13	0.93%
Spain	27	1.93%	Portugal	10	0.71%
South Africa	24	1.71%	Singapore	10	0.71%
Taiwan	21	1.50%	Thailand	10	0.71%
Netherlands	20	1.43%	Other	50	3.57%
Switzerland	20	1.43%	Total	1,402	100.00%

This table gives an overview of our sample used for the baseline analysis. Panel A gives an overview of the industry distribution of the companies included in the baseline analysis using the Vigeo Eiris sector classification. Panel B gives an overview of the global distribution of the companies included in the baseline analysis by country of a company's headquarters. Both panels are sorted by frequency. For brevity, we display all countries with fewer than ten companies as single group (Other). Other includes Austria, Colombia, the Czech Republic, Greece, Hungary, Ireland, Israel, the Philippines, Qatar, Turkey, and the United Arab Emirates. For our empirical analyses, we use country fixed effects for all countries, including those with fewer than ten companies.

Table VI-4: Descriptive analysis

VARIABLES	N	Median	Mean	Std. Dev.	P25	P75
Biodiversity	7,161	28.0000	31.7713	19.3809	14.0000	43.0000
Biodiv. Leadership	7,161	30.0000	31.5353	29.7860	0.0000	52.0000
Biodiv. Implementation	7,161	20.0000	27.3586	28.4442	0.0000	44.0000
Biodiv. Results	7,161	35.0000	36.2955	15.0913	28.0000	35.0000
DUVOL	7,161	0.1137	0.1151	0.7772	-0.3642	0.5923
NCSKEW	7,161	0.1116	0.1256	1.0385	-0.4545	0.6751
LAGNCSKEW	7,161	0.1200	0.1555	0.9485	-0.4356	0.6779
SIGMA	7,161	0.0419	0.0477	0.0237	0.0311	0.0577
RET	7,161	0.1398	0.1361	0.6347	-0.2309	0.5043
DTURNOVER	7,161	0.0000	0.0010	0.0338	-0.0094	0.0098
SIZE	7,161	8.8110	8.8537	1.3873	7.9293	9.7411
MB	7,161	1.8200	2.8646	3.8380	1.1100	3.2100
LEV	7,161	0.2198	0.2313	0.1519	0.1229	0.3235
ROA	7,161	0.0416	0.0512	0.0771	0.0165	0.0810
OPAQUE	7,161	0.7897	0.6464	0.4146	0.5609	0.9064
ESG	7,161	58.9600	56.8385	19.4279	43.6700	72.1100

This table reports the summary statistics of the variables deployed in the baseline analysis. We winsorize all control variables at the 1 percent and 99 percent levels.

Table VI-5: Correlation analysis

	VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1)	Biodiversity	1.00															
(2)	Biodiv. Leadership	0.88*	1.00														
(3)	Biodiv. Implementation	0.88*	0.64*	1.00													
(4)	Biodiv. Results	0.47*	0.20*	0.22*	1.00												
(5)	DUVOL	-0.02	-0.02*	-0.01	-0.02	1.00											
(6)	NCSKEW	-0.02	-0.02	-0.01	-0.02	0.92*	1.00										
(7)	LAGNCSKEW	-0.05*	-0.04*	-0.03*	-0.03*	-0.01	0.00	1.00									
(8)	SIGMA	-0.02	-0.04*	-0.03*	0.06*	-0.09*	-0.09*	-0.08*	1.00								
(9)	RET	0.03*	0.03*	0.03*	0.00	0.08*	0.06*	-0.49*	0.03*	1.00							
(10)	DTURNOVER	-0.02*	-0.02	-0.02*	0.00	-0.03*	-0.03*	0.04*	0.29*	-0.07*	1.00						
(11)	SIZE	0.28*	0.29*	0.31*	-0.06*	0.08*	0.07*	0.03*	-0.39*	-0.01	-0.05*	1.00					
(12)	MB	0.03*	0.04*	0.03*	-0.01	-0.02	-0.01	-0.01	0.07*	-0.01	0.00	-0.04*	1.00				
(13)	LEV	0.04*	0.05*	0.03*	0.02	0.00	0.00	0.02*	-0.01	-0.04*	0.05*	0.04*	-0.05*	1.00			
(14)	ROA	0.03*	0.03*	0.03*	-0.01	-0.02	-0.02	-0.09*	-0.14*	0.21*	-0.05*	0.20*	-0.03*	-0.17*	1.00		
(15)	OPAQUE	-0.04*	-0.04*	-0.04*	-0.01	0.01	0.02	0.01	-0.12*	0.00	-0.02	0.01	0.01	0.04*	0.04*	1.00	
(16)	ESG	0.51*	0.50*	0.48*	0.08*	-0.01	0.01	0.01	-0.12*	0.02	-0.01	0.43*	0.02	0.05*	0.07*	-0.03*	1.00

This table reports the pairwise correlation coefficients of the variables deployed in the baseline analysis. Significance at the 5 percent level is indicated by *.

Table VI-6: DUVOL regression analysis

VARIABLES	(1) DUVOL	(2) DUVOL	(3) DUVOL	(4) DUVOL
Biodiversity	-0.0017***			
	(0.0006)			
Biodiv. Leadership		-0.0010**		
		(0.0004)		
Biodiv. Implementation			-0.0011***	
			(0.0004)	
Biodiv. Results				-0.0001
				(0.0006)
LAGNCSKEW	0.0229*	0.0233*	0.0232*	0.0242*
	(0.0128)	(0.0128)	(0.0128)	(0.0129)
SIGMA	-2.2474***	-2.2501***	-2.2515***	-2.2632***
	(0.6766)	(0.6767)	(0.6771)	(0.6772)
RET	0.1379***	0.1384***	0.1382***	0.1390***
	(0.0200)	(0.0200)	(0.0200)	(0.0200)
DTURNOVER	-0.0624	-0.0692	-0.0571	-0.0618
	(0.3386)	(0.3387)	(0.3388)	(0.3389)
SIZE	0.0332***	0.0323***	0.0342***	0.0284***
	(0.0101)	(0.0101)	(0.0101)	(0.0100)
MB	0.0036	0.0036	0.0035	0.0036
	(0.0027)	(0.0027)	(0.0027)	(0.0027)
LEV	-0.0778	-0.0788	-0.0821	-0.0825
	(0.0695)	(0.0695)	(0.0694)	(0.0691)
ROA	0.5470***	0.5445***	0.5443***	0.5580***
	(0.1637)	(0.1636)	(0.1636)	(0.1632)
OPAQUE	0.0021	0.0017	0.0025	0.0025
	(0.0224)	(0.0223)	(0.0224)	(0.0224)
ESG	-0.0007	-0.0007	-0.0008	-0.0013**
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Constant	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	7,161	7,161	7,161	7,161
Adjusted R-squared	0.0361	0.036	0.036	0.0352

This table reports the results of an OLS estimation of Eq. (4), regressing the Biodiversity score on DUVOL as one of two different measures of stock price crash risk. Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively. Standard errors clustered at the firm level in parentheses below each coefficient. We winsorize all control variables at the 1 percent and 99 percent level.

Table VI-7: NCSKEW regression analysis

VARIABLES	(1) NCSKEW	(2) NCSKEW	(3) NCSKEW	(4) NCSKEW
Biodiversity	-0.0027***			
	(0.0008)			
Biodiv. Leadership		-0.0015***		
		(0.0005)		
Biodiv. Implementation			-0.0016***	
			(0.0005)	
Biodiv. Results				-0.0005
				(0.0008)
LAGNCSKEW	0.0314*	0.0319*	0.0320*	0.0333*
	(0.0183)	(0.0182)	(0.0183)	(0.0183)
SIGMA	-3.0135***	-3.0173***	-3.0214***	-3.0371***
	(0.9215)	(0.9229)	(0.9216)	(0.9236)
RET	0.1644***	0.1653***	0.1651***	0.1660***
	(0.0273)	(0.0272)	(0.0273)	(0.0273)
DTURNOVER	-0.1147	-0.1254	-0.1071	-0.1129
	(0.4359)	(0.4363)	(0.4364)	(0.4363)
SIZE	0.0343**	0.0330**	0.0352***	0.0267**
	(0.0133)	(0.0134)	(0.0133)	(0.0133)
MB	0.0021	0.0021	0.002	0.0022
	(0.0039)	(0.0039)	(0.0039)	(0.0039)
LEV	-0.0227	-0.0243	-0.0296	-0.029
	(0.0937)	(0.0936)	(0.0935)	(0.0933)
ROA	0.5786**	0.5744**	0.5761**	0.5973***
	(0.2298)	(0.2301)	(0.2300)	(0.2301)
OPAQUE	0.0059	0.0053	0.0066	0.0065
	(0.0286)	(0.0285)	(0.0287)	(0.0287)
ESG	0.0002	0.0001	0.0000	-0.0006
	(0.0009)	(0.0009)	(0.0009)	(0.0008)
Constant	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	7,161	7,161	7,161	7,161
Adjusted R-squared	0.0286	0.0285	0.0283	0.0273

This table reports the results of an OLS estimation of Eq. (4), regressing the Biodiversity score on NCSKEW as one of two different measures of stock price crash risk. Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively. Standard errors clustered at the firm level in parentheses below each coefficient. We winsorize all control variables at the 1 percent and 99 percent level.

Table VI-8: Interaction analysis

VARIABLES	(1) DUVOL	(2) NCSKEW	(3) DUVOL	(4) NCSKEW	(5) DUVOL	(6) NCSKEW	(7) DUVOL	(8) NCSKEW
Biodiv. Results (X)	0.0002	0.0000	0.0005	0.0003	0.0004	0.0001	0.0004	0.0004
	(0.0007)	(0.0009)	(0.0006)	(0.0009)	(0.0006)	(0.0009)	(0.0007)	(0.0009)
Biodiv. Leadership	-0.0012**	-0.0016**						
	(0.0005)	(0.0007)						
Biodiv. Implementation			-0.0016***	-0.0022***				
			(0.0005)	(0.0007)				
Interaction term (below median)								
X * Low Biodiv. Leadership	-0.0004	-0.0002						
	(0.0007)	(0.0010)						
X * Low Biodiv. Implementation			-0.0009	-0.001				
			(0.0008)	(0.0010)				
X * Low ROA					-0.0013**	-0.0014*		
					(0.0006)	(0.0008)		
X * Low ESG							-0.0017**	-0.0025**
							(0.0008)	(0.0011)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,161	7,161	7,161	7,161	7,161	7,161	7,161	7,161
Adjusted R-squared	0.0358	0.0282	0.036	0.0282	0.0356	0.0276	0.0357	0.0281

This table reports the results of an OLS estimation, regressing the score capturing stakeholder feedback on biodiversity management on DUVOL and NCSKEW as our two different measures of stock price crash risk. We add interaction terms between the Biodiversity Results score and several dummy variables. We assign the dummy variable (i.e., Low Biodiv. Leadership) a value of one if the value of a firm-year observation (i.e., in terms of Biodiv. Leadership) is smaller than the median value of this variable in our whole sample, and zero otherwise. We include all control variables used in the main regression (Table 6 and Table 7). Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively. Standard errors clustered at the firm level in parentheses below each coefficient. We winsorize all control variables at the 1 percent and 99 percent level.

Table VI-9: Environmental inspection subsample descriptive analysis

	Treatment Group		Control Group		
VARIABLES	No.	Mean	No.	Mean	Diff
DUVOL	57	0.3671	57	0.4103	-0.0432
NCSKEW	57	0.4355	57	0.4448	-0.0092
LAGNCSKEW	57	0.4773	57	0.2604	0.2169
SIGMA	57	0.0310	57	0.0388	-0.0077***
RET	57	0.0782	57	0.0985	-0.0203
DTURNOVER	57	-0.0056	57	0.0006	-0.0062
SIZE	57	10.0193	57	9.3377	0.6816***
MB	57	3.7768	57	3.3574	0.4195
LEV	57	0.3037	57	0.3035	0.0002
ROA	57	0.0791	57	0.0661	0.0130
OPAQUE	57	0.5852	57	0.7467	-0.1615**
ESG	57	61.9253	57	47.013	14.9123***

This table provides a summary of the variables used in the difference-indifferences regression for both treatment and control firms one year prior to the respective merger. Firms are assigned to the treatment group if their facilities were subject to an inspection by the US environmental protection agency (EPA). The potential control group consists of all firms that had no inspection during the entire sample period. Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively.

Table VI-10: Environmental inspection subsample difference-in-differences analysis

	(1)	(2)
VARIABLES	NCSKEW	DUVOL
Post	-0.4779**	-0.3681**
	(0.2241)	(0.1506)
Treat*Post	0.4481*	0.3352*
	(0.2682)	(0.1810)
Treat	-0.0629	-0.0717
	(0.2011)	(0.1413)
Constant	Yes	Yes
Controls	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	301	301
Adjusted R-squared	0.0742	0.1199

This table reports the results of a difference-in-differences estimation using a propensity score matched sample. Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively. Robust standard errors are reported in parentheses below each coefficient. We winsorize all control variables at the 1 percent and 99 percent level.

Table VI-11: High-risk industries analysis

VARIABLES	(1) DUVOL	(2) NCSKEW	(3) DUVOL	(4) NCSKEW	(5) DUVOL	(6) NCSKEW	(7) DUVOL	(8) NCSKEW
High Risk	0.0736	0.1161	0.0939	0.129	0.0991	0.1348	0.0798	0.1301
	(0.1003)	(0.1254)	(0.0972)	(0.1213)	(0.0954)	(0.1187)	(0.1066)	(0.1329)
Biodiversity	-0.0027***	-0.0036***						
	(0.0008)	(0.0011)						
Biodiv. Leadership			-0.0015***	-0.0020**				
			(0.0006)	(0.0008)				
Biodiv. Implementation					-0.0020***	-0.0025***		
					(0.0005)	(0.0008)		
Biodiv. Results							-0.0007	-0.0008
							(0.0009)	(0.0013)
Interaction term (high risk industry)								
High Risk * Biodiversity	0.0018*	0.0017						
	(0.0010)	(0.0014)						
High Risk * Biodiv. Leadership			0.0008	0.0008				
			(0.0007)	(0.0009)				
High Risk * Biodiv. Implementation					0.0016**	0.0017*		
					(0.0007)	(0.0010)		
High Risk * Biodiv. Results							0.001	0.0006
							(0.0013)	(0.0017)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,161	7,161	7,161	7,161	7,161	7,161	7,161	7,161
Adjusted R-squared	0.0364	0.0287	0.0361	0.0284	0.0365	0.0286	0.0351	0.0272

This table reports the results of an OLS estimation, regressing our measures of biodiversity management on our two different measures of stock price crash risk, DUVOL and NCSKEW. We add interaction terms between the biodiversity management (sub)scores and a dummy variable indicating sectors at high risk regarding biodiversity loss. We assign the dummy variable a value of one if the company is active in a red zone sector, defined by F&C Asset Management (2004), and zero otherwise. We include all control variables used in the main regression (Table 6 and Table 7). Significance at the 1, 5, and 10 percent levels is indicated by ***, **, and *, respectively. Standard errors clustered at the firm level in parentheses below each coefficient. We winsorize all control variables at the 1 percent and 99 percent level.

Part VII: Summary of Publications and Declarations

1. Short Summary of Articles and Current Status of Papers (§6 (2, 7) PromO)

1.1 How does Sustainability Assurance Affect a Company's Internal Information Environment?

Alexander Bassen, Kerstin Lopatta, Anna Rafaela Rudolf, Sebastian Tideman

Abstract in English: We investigate how sustainability assurance (SA) affects a firm's internal information environment (IIE) by complementing archival data with insights from semi-structured interviews conducted with representatives from assurance providers (N=15) and receivers (N=20) from seven different countries. To establish and document a robust positive empirical relationship between SA and the IIE, we initially capture firms' internal distribution of information by differences in insider trading profits across their locations. Next, with our interview data, we explore the specific mechanisms of how SA triggers modifications within a firm. Considering an organization as an amalgam of sub-systems, a design archetype, and interpretative schemes, SA triggers change across all three of these components. Our field data indicate that SA changes organizations' systems, processes, and governance structures. We observe specific effect channels: SA lowers internal barriers, creates novel communication channels that unlock silo structures, and empowers and motivates employees.

Abstract in German: Diese Studie untersucht, wie sich die externe und unabhängige Prüfung von Nachhaltigkeitsveröffentlichungen (engl. sustainability assurance - SA) auf das interne Informationsumfeld (engl. internal information environment - IIE) von Unternehmen auswirkt. Dazu kombinieren wir Archivdaten mit Erkenntnissen aus semistrukturierten Interviews, die wir mit Repräsentanten von Prüfungsdienstleistern (N=15) und Prüfungsempfängern (N=20) aus sieben verschiedenen Ländern geführt haben. Um einen robusten positiven empirischen Zusammenhang zwischen der unabhängigen Prüfung von Nachhaltigkeitsveröffentlichungen und dem internen Informationsumfeld zu identifizieren und zu dokumentieren, erfassen wir zunächst die unternehmensinterne Informationsverteilung, gemessen durch die Differenzen in den Handelsprofiten mit firmeneigenen Aktien zwischen Managern an verschiedenen Unternehmensstandorten. Anschließend untersuchen wir mit Hilfe der erhobenen Interviewdaten die spezifischen Mechanismen, durch welche Veränderungen durch die Prüfung von Nachhaltigkeitsveröffentlichungen innerhalb eines Unternehmens sichtbar werden. Die Analyse ergibt, dass, unter der Betrachtung einer Organisation als ein Amalgam aus Subsystemen (physische Elemente), einem Design-Archetyp (Prozesse und Strukturen) und Interpretationsschemata (Werten), die Prüfung von Nachhaltigkeitsveröffentlichungen strukturelle Veränderungen in allen

drei Komponenten induziert. Unsere Felddaten zeigen, dass die Prüfung von Nachhaltigkeitsveröffentlichungen die Systeme, Prozesse und Governance-Strukturen von Organisationen verändert. Dabei beobachten wir spezifische Wirkungskanäle: Die Prüfung von Nachhaltigkeitsveröffentlichungen senkt interne Barrieren, schafft neue Kommunikationskanäle, bricht Silostrukturen auf und befähigt sowie motiviert Mitarbeitende.

Current status: Working Paper, target journal *Contemporary Accounting Research* (VHB A)

1.2 Sustainability Assurance and Resource Adjustments: The Case of Cost Asymmetry

Alexander Bassen, Kerstin Lopatta, Laura-Maria Gastone, Anna Rafaela Rudolf, Sebastian Tideman

Abstract in English: This paper investigates whether the sustainability assurance (SA) process affects firms' resource adjustments. We combine archival data with field data gathered through interviews with company representatives (N=20) and SA providers (N=15). From our interview data, we derive that SA could help companies develop a deeper understanding of their operations related to environmental, social, and governance (ESG) data. Moreover, SA enables managers to strategically incorporate ESG-related data into their decision-making, which enriches the underlying set of information they can refer to when making resource adjustments. Using archival data, we then analyze the impact of SA on management decisions regarding resource adjustments utilizing cost stickiness as the empirical proxy (i.e., under-adjustment of expenses in the event of a sales decline). Drawing on a sample of 1,631 firms across 40 countries, we observe that SA leads to greater cost adjustments in the event of a decline in sales, resulting in an overall reduction in cost stickiness. Notably, the SA-induced reduction in cost asymmetry is associated with higher firm value.

Abstract in German: Dieses Papier untersucht, ob der Prozess der externen und unabhängigen Prüfung von Nachhaltigkeitsveröffentlichungen (Sustainability Assurance - SA) die Ressourcenanpassung von Unternehmen beeinflusst. Wir kombinieren Archivdaten mit Felddaten. Diese wurden durch Interviews mit Unternehmensvertretern (20 Personen) und Anbietern von Nachhaltigkeitsprüfungen (15 Personen) erhoben. Auf der Grundlage unserer Interviewdaten kommen wir zu dem Schluss, dass die Prüfung von Nachhaltigkeitsveröffentlichungen den Unternehmen dabei helfen kann, ein tieferes Verständnis für ihre betrieblichen Abläufe in Bezug auf Nachhaltigkeitsdaten zu entwickeln. Darüber hinaus ermöglicht die Prüfung den Managern, Nachhaltigkeitsdaten strategisch in ihre Entscheidungsfindung einzubeziehen. Dies verbessert

die zugrundeliegende Informationsbasis, auf die sie sich bei der Ressourcenanpassung stützen. Auf der Grundlage von Archivdaten wird anschließend der Einfluss von Nachhaltigkeitsinformationen auf bewusste Managemententscheidungen zur Ressourcenanpassung analysiert. Als empirisches Instrument verwenden wir Kostenremanenzen (engl. cost stickiness, d. h. die unzureichende Anpassung der Kosten im Falle eines Umsatzrückgangs). Basierend auf einer Stichprobe von Unternehmen aus 40 Ländern finden wir, dass die Prüfung von Nachhaltigkeitsveröffentlichungen effektiv zu höheren Kostenanpassungen bei Umsatzrückgängen führt, was wiederum zu einer Verringerung der Kostenremanenzen führt. Besonders hervorzuheben ist, dass die durch die Prüfung von Nachhaltigkeitsveröffentlichungen induzierte Reduktion der Kostenremanenzen mit einem höheren Unternehmenswert einhergeht.

Current status: Working Paper, submitted to the *Review of Accounting Studies* (VHB Ranking A)

1.3 The Moderating Role of CEO Sustainability Reporting Style in the Relationship between Sustainability Performance, Sustainability Reporting, and Cost of Equity

Kerstin Lopatta, Thomas Kaspereit, Sebastian Tideman, Anna Rafaela Rudolf

Abstract in English: This paper explores the role of individual managers in the relationship between sustainability performance, sustainability reporting, and cost of equity. Based on prior research showing that both sustainability performance and reporting reduce the risk premium, this paper contributes to the literature by acknowledging that the true motives behind a manager's corporate sustainability engagement are not apparent to investors. Thus, investors need further information to assess the relationship between sustainability performance and risk. We argue that CEOs' values and preferences drive their decisions regarding sustainability activities. Thus, their fixed effect on sustainability reporting conveys a signal to investors about the motives behind corporate sustainability engagement and the extent of reporting. In the first step of our empirical analysis, we document that a CEO's specific reporting style has significant statistical power in explaining a company's level of sustainability reporting. In the second step, we find that improved sustainability performance is associated with increased cost of equity when the CEO exerts a strong personal influence on sustainability reporting. However, the cost of equity declines if the CEO's influence on the reporting of improved sustainability performance is low. Our results are consistent with the argument that investors interpret a CEO's fixed-effect on sustainability reporting as a signal. That is, for a high CEO fixed-effect,

increases in sustainability engagement are conflated with the CEO's self-interested values. In further tests, we show that the signal seems to be particularly important for normative sustainability activities (vs. legal sustainability activities).

Abstract in German: Diese Veröffentlichung untersucht die Rolle einzelner Manager in der Beziehung zwischen Nachhaltigkeitsperformance, Nachhaltigkeitsberichterstattung und Eigenkapitalkosten. Aufbauend auf früheren Forschungsergebnissen, die zeigen, dass sowohl Nachhaltigkeitsperformance als auch Nachhaltigkeitsberichterstattung zu einer Verringerung der Risikoprämie führen, trägt diese Veröffentlichung zur Literatur bei, indem sie herausstellt, dass die wahren Motive hinter dem Nachhaltigkeitsengagement eines Managers für Investoren nicht offensichtlich sind. Investoren müssen sich daher auf zusätzliche Informationen stützen, um die Beziehung zwischen Nachhaltigkeitsperformance und Risiko beurteilen zu können. Wir argumentieren, dass CEO-Entscheidungen bezüglich Nachhaltigkeitsaktivitäten von deren persönliche Werte und Präferenzen beeinflusst werden. Der spezifische, individuelle Effekt auf die Nachhaltigkeitsberichterstattung liefert Investoren daher ein Signal über die Motive hinter dem Nachhaltigkeitsengagement von Unternehmen und dem Umfang der Berichterstattung. Im ersten Schritt unserer empirischen Analyse zeigen wir, dass der spezifische Berichterstattungsstil eines CEOs tatsächlich einen statistisch signifikanten Effekt auf den Umfang der Nachhaltigkeitsberichterstattung eines Unternehmens hat. In einem zweiten Schritt zeigen wir, dass eine bessere Nachhaltigkeitsperformance mit höheren Eigenkapitalkosten verbunden ist, wenn der CEO einen starken persönlichen Einfluss auf die Nachhaltigkeitsberichterstattung ausübt. Die Eigenkapitalkosten sinken jedoch, wenn der Einfluss des CEO auf die Berichterstattung über die verbesserte Nachhaltigkeitsperformance gering ist. Unsere Ergebnisse sind konsistent mit dem Argument, dass Investoren den individuellen Einfluss des CEO auf die Nachhaltigkeitsberichterstattung als Signal interpretieren. Dies bedeutet, dass im Falle eines hohen individuellen Effekts ein erhöhtes Nachhaltigkeitsengagement mit eigennützigen Werten des CEO assoziiert wird. In weiteren Tests zeigen wir, dass das Signal für freiwillige Nachhaltigkeitsaktivitäten (im Gegensatz zu gesetzlichen geforderten Nachhaltigkeitsaktivitäten) besonders wichtig zu sein scheint.

Current status: Published in the *Journal of Business Economics* (VHB Ranking B)

1.4 Evolution, Motives, and Perception of Biodiversity-Related Disclosure: The Application of GRI 304

Anna Rafaela Rudolf

Abstract in English: In the context of current regulatory developments worldwide, the impact of companies on biodiversity and the risks arising from the continuing loss of biodiversity are of major political relevance. So-called biodiversity risks emerge from the loss of biodiversity and the general alteration of ecosystems by humans. Recent research has focused on climate change and the risks posed by global warming. However, the question remains to what extent companies and investors are aware of biodiversity loss and the related risks. This study looks specifically at reported biodiversity impacts and activities, particularly those following the Global Reporting Initiative's (GRI) topic-specific standard, GRI 304. First, I analyze companies' biodiversity disclosures according to GRI 304 and find that biodiversity-related disclosure (BRD) has not changed from 2010 to 2019, suggesting a) a lack of internal awareness, and b) low external pressure on companies. Further analysis shows that climate risk awareness is an important driver of BRD and that high-quality BRD is associated with higher perceived risk. Furthermore, I find that the high-quality BRD is valued by wider stakeholder groups.

Abstract in German: Die Auswirkungen von Unternehmen auf die Biodiversität und die Risiken, die sich aus dem fortschreitenden Verlust der Biodiversität ergeben, sind vor dem Hintergrund aktueller globaler regulatorischer Entwicklungen von großer politischer Bedeutung. Biodiversitätsrisiken ergeben sich aus dem Verlust biologischer Vielfalt und der generellen Veränderung von Ökosystemen durch den Einfluss des Menschen. Die neuere Forschung hat sich auf den Klimawandel und die mit der globalen Erwärmung verbundenen Risiken konzentriert. Es stellt sich jedoch die Frage, inwieweit sich Unternehmen und Investoren des Biodiversitätsverlustes und der damit verbundenen Risiken bewusst sind. Die vorliegende Studie konzentriert sich auf die berichteten Auswirkungen und Aktivitäten im Bereich der Biodiversität, insbesondere auf solche, die dem themenspezifischen Standard GRI 304 der Global Reporting Initiative (GRI) folgen. Zunächst wird die Biodiversitätsberichterstattung der Unternehmen nach GRI 304 analysiert. Die Ergebnisse zeigen, dass sich die Biodiversitätsberichterstattung zwischen 2010 und 2019 nicht weiterentwickelt hat, was a) auf ein mangelndes internes Bewusstsein und b) auf einen geringen externen Druck auf die Unternehmen schließen lässt. Weitere Analysen zeigen, dass das Bewusstsein für Klimarisiken eine wichtige Determinante für

eine qualitativ gute Biodiversitätsberichterstattung ist. Darüber hinaus zeigt sich, dass eine qualitativ hochwertige Biodiversitätsberichterstattung mit einer höheren Risikowahrnehmung der Investoren einhergeht. Außerdem zeigt sich, dass eine qualitativ hochwertige Berichterstattung von breiteren Stakeholdergruppen geschätzt wird.

Current status: Working Paper, submitted to the *European Accounting Review* (VHB Ranking A)

1.5 Biodiversity Management and Stock Price Crash Risk

Alexander Bassen, Daniel Buchholz, Kerstin Lopatta, Anna Rafaela Rudolf

Abstract in English: This study examines the relationship between corporate biodiversity management and financial risk. While the increasing loss of biodiversity and ecosystem services is seen as an important risk factor on a societal level, the financial consequences of these risks on a company level have thus far been neglected by empirical financial research. We posit that strong corporate actions aimed at preserving biodiversity reduces firms' financial risks. Using a global sample and novel data on firms' biodiversity management, our results show that companies with stronger structures, implementations, and actions around biodiversity management see a decline in stock price crash risk. In an additional analysis, we focus on environmental inspections as a possible conduit for releasing potentially negative information on biodiversity management. Using a subsample of North American firms, we find that firms which have been inspected record an increase in their stock price crash risk.

Abstract in German: In der vorliegenden Studie wird der Zusammenhang zwischen unternehmerischem Biodiversitätsmanagement und finanziellem Risiko untersucht. Während der fortschreitende Verlust von Biodiversität und Ökosystemleistungen auf gesellschaftlicher Ebene als wichtiger Risikofaktor angesehen wird, wurden die finanziellen Auswirkungen dieser Risiken auf Unternehmensebene in der empirischen Finanzforschung bisher weitgehend vernachlässigt. Wir postulieren, dass ein starkes unternehmerisches Engagement für den Erhalt der Biodiversität die finanziellen Risiken für Unternehmen verringert. Unsere Ergebnisse, die auf einer globalen Stichprobe und neuartigen Daten zum Biodiversitätsmanagement von Unternehmen basieren, zeigen, dass Unternehmen mit stärkeren Strukturen, Umsetzungen und Maßnahmen im Bereich Biodiversitätsmanagement ein geringeres Risiko von Kurseinbrüchen aufweisen. In einem weiteren Schritt konzentrieren wir uns auf Umweltinspektionen als möglichen Kanal für

die Veröffentlichung negativer Informationen über das Biodiversitätsmanagement. Anhand einer Teilstichprobe nordamerikanischer Unternehmen stellen wir fest, dass Unternehmen, deren Betriebe inspiziert wurden, ein höheres Risiko für einen Kurseinbruch aufweisen.

Current status: Working Paper, invitation for resubmission to the Journal of *Business Strategy and Environment* (VHB Ranking B)

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

This tables display my personal contribution to the articles included in this dissertation. The categories used are based on PromO, the extent to which I contributed is outlined based on the following scale:

- My contribution is 67%-100%: A
- My contribution is 34%-66%: B
- My contribution is 0-33%: C

Article 1

How does Sustainability Assurance Affect a Company's Internal Information Environment *(Alexander Bassen, Kerstin Lopatta, Anna R. Rudolf, and Sebastian Tideman)*	
Theory and Design	B
Empirical Execution	A
Preparation of Manuscript	A

Article 2

Sustainability Assurance and Resource Adjustments: The Case of Cost Asymmetry *(Alexander Bassen, Laura-Maria Gastone, Kerstin Lopatta, Anna R. Rudolf, and Sebastian Tideman)*	
Theory and Design	B
Empirical Execution	A
Preparation of Manuscript	B

Article 3

The Moderating Role of CEO Sustainability Reporting Style in the Relationship between Sustainability Performance, Sustainability Reporting, and Cost of Equity ***(****Kerstin Lopatta, Thomas Kaspereit, Sebastian Tideman, Anna R. Rudolf)*	
Theory and Design	C
Empirical Execution	A
Preparation of Manuscript	B

Article 4

Evolution, Motives, and Perception of Biodiversity-Related Disclosure: The Application of GRI 304 (*Anna R. Rudolf)*	
Theory and Design	A
Empirical Execution	A
Preparation of Manuscript	A

Article 5

Biodiversity Management and Stock Price Crash Risk (*Alexander Bassen, Daniel Buchholz, Kerstin Lopatta, Anna R. Rudolf)*	
Theory and Design	B
Empirical Execution	C
Preparation of Manuscript	B

3. Statutory Declaration (§6 (6) PromO)

Erklärung

Hiermit erkläre ich, Anna Rafaela Rudolf, 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, den 02.08.2023

Ort/Datum Unterschrift

Eidesstattliche Versicherung

Ich, Anna Rafaela Rudolf, versichere an Eides statt, dass ich die Dissertation mit dem Titel " EMPIRICAL EVIDENCE ON INTERNAL AND EXTERNAL MANAGERIAL DECISION MAKING IN SUSTAINABLE FINANCE AND DISCLOSURE" 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, den 02.08.2023

Ort/Datum Unterschrift