TCFD Reporting: Early Evidence Related to the Future of Global Climate-Related Disclosures*

Elizabeth Demers[$]
Jurian Hendrikse[€]
Marcel Metzner[£]

February 2024

Keywords: TCFD; CDP; ISSB; Climate-Related Disclosures; Transition Risk; Physical Risk; Regulatory Risk; ESG; Sustainability Reporting

JEL Classifications: D8, F3, G1, G3, M4, Q5

---

* We appreciate discussions with Anette Mikes, as well as helpful comments on an earlier version of this study from Carolina Arlota, Jonathan Berk, Kareen Brown, Vincent Giese, Claudine Mangen, Lécia Vicente, and conference participants at the Henry G. Manne Program in Law & Economics Studies' September 2021 Research Roundtable on Capitalism & the Rule of Law, the 2nd annual Canadian Sustainable Finance Network (CSFN) Conference, the 2023 Tel Aviv Accounting Conference, the 2023 Sustainability, ESG, and Value Creation Conference at Brock University, and workshop participants at Concordia University and Wilfred Laurier University. We also thank Quincy McKinney for capable research assistance. The opinions expressed here are those of the authors and do not represent the official position of the Law & Economics Center, George Mason University, nor of any other organization with which the authors are affiliated.
Funding for this project was provided by the CPA Ontario Centre for Sustainability Reporting and Performance Management at the University of Waterloo and by a grant from the Law & Economics Center at George Mason University Antonin Scalia Law School (Demers), as well as by the Saïd School of Business, University of Oxford (Metzner). Hendrikse thanks the CentER Graduate School at Tilburg University for financial support. Part of this work was completed while Hendrikse visited the University of North Carolina at Chapel Hill. The authors have no conflicts of interest to declare. All data are from public sources.
[$] School of Accounting and Finance, University of Waterloo, Ontario, Canada. elizabeth.demers@uwaterloo.ca
[€] Tilburg School of Economics and Management, Tilburg University, Warandelaan 2, 5000 LE Tilburg, The Netherlands. j.c.p.hendrikse@tilburguniversity.edu
[£]Saïd Business School, University of Oxford, Oxford, UK. marcel.metzner@sbs.ox.ac.uk

TCFD Reporting: Early Evidence Related to the Future of Global Climate-Related Disclosures

Abstract

The Task Force on Climate-Related Financial Disclosures ("TCFD") is globally recognized as the "gold standard" of climate-related reporting. The TCFD underlies the recently issued IFRS S2 Climate-Related Disclosures standard and California regulations, the anticipated SEC regulations, as well as numerous country-specific climate disclosure mandates. This study provides the first comprehensive evidence on the determinants and market-implications of TCFD-compliant climate risk, opportunities, and financial impact disclosures for a global sample of firms headquartered in advanced economies. Utilizing voluntary TCFD-aligned information reported to the CDP from the initiation of TCFD reporting in 2018 through 2022, we first provide evidence on which firms are likely to face larger adjustment costs when the various new TCFD-based disclosure mandates become effective. Our capital markets tests reveal that the act of responding to the CDP survey is not associated with market values in fully specified regression models. We further find that disclosing to the CDP is negatively associated with equity market bid-ask spreads, consistent with disclosure reducing information asymmetry, although the results do not hold for U.S. and Japanese firms. Our findings on the market-relevance of TCFD-compliant climate-related disclosures are also decisively mixed. The number of transition risks disclosed is negatively associated with market values, consistent with the market viewing these as unrecorded liabilities or unrecognized asset impairments. By contrast, climate-related opportunities are not associated with market-based measures, suggesting that these disclosures may be viewed as "cheap talk." The TCFD-solicited estimated financial impacts of climate risks and opportunities are also surprisingly unassociated with market metrics, suggesting that the market does not seem to be attentive to, to comprehend, and/or to consider these estimates to be of sufficient credibility or materiality for them to be reflected in prices.

1. Introduction

Climate-related considerations have become a primary concern of sustainable investors. Addressing the lack of high-quality and comparable material climate risk information available to investors (CFTC, 2020; Herren Lee, 2021; IFRS Foundation, 2021), California has passed two climate-related disclosure bills, the U.S. SEC is preparing to issue new climate-related disclosure regulations for its registrants, the International Sustainability Standards Board ("ISSB"), backed by the International Organization of Securities Commissions ("IOSCO") and many individual securities regulators around the world, has recently issued their IFRS S2 climate disclosure standard, and numerous countries have issued mandatory climate disclosure rules for companies in their jurisdiction (ISSB, 2022a; US SEC, 2022; TCFD 2022; European Commission, 2023; Engler 2023). Importantly, all of these standards and regulations are based upon the framework of the Task Force on Climate-Related Financial Disclosures ("TCFD"). This study provides the first comprehensive global evidence related to corporate voluntary TCFD-related climate disclosures by companies headquartered in advanced economies. We provide evidence related to the market-relevance of these disclosures, as well as the firm- and country-level characteristics associated with the voluntary provision of TCFD disclosures. The latter results provide insights into which currently non-disclosing companies are likely to face greater adjustment costs in the face of the new standards and regulations, as well as which companies' stakeholders potentially have the most information to gain from the new disclosures. The market-related tests highlight the extent to which investors price voluntary TCFD-aligned climate-related disclosures. Our findings are important in light of the now-effective IFRS climate disclosure standard, the recent issuance of the Task Force on Nature-related Financial Disclosures (TNFD) framework that parallels the TCFD, and in anticipation of various other regulations and mandates of TCFD-based climate disclosures around the world.

Globally recognized as the "gold standard" for climate-related disclosures (Mooney & Nauman, 2020), the TCFD recommendations were born out of a market need for enhanced company-provided information when it became clear that markets were not adequately pricing in climate-related risks (CFTC, 2020). The TCFD was established by the Financial Stability Board ("FSB") in 2015 with a mandate to fill the gap in climate-related disclosures.[1] A private-sector-

[1] According to their website, the FSB, "through its members, seeks to strengthen financial systems and increase the stability of the international financial markets… The FSB promotes international financial stability; it does so by

led taskforce, the TCFD published its recommendations on climate-related financial disclosures in 2017, and a growing number of companies have been voluntarily reporting under its guidelines since 2018. Distinguishing features of the TCFD's climate-related financial disclosure recommendations are that they are designed to elicit company-provided information about the risks and opportunities that the firm faces as a result of climate change – i.e., these are disclosures related to *the impact of climate change on the firm,* rather than information about *the firm's impact on the environment* such as the greenhouse gas emissions that have been the topic of considerable prior capital markets research (e.g., Matsumura et al., 2014; Jung et al., 2018; and Aswani et al., 2023, amongst many others). Although other stakeholders may also find the TCFD-solicited information to be of interest, the TCFD's specific mandate is to help to improve the quality and consistency of corporate disclosures related to climate information targeted at the firm's *financial stakeholders*, including lenders, shareholders, and insurers. Since its inception, the Michael Bloomberg-chaired TCFD has received an extremely high and continuously growing level of support.[2] Most notably, given the SEC's mandate to *protect investors* (i.e., rather than the environment or society at large) and the ISSB's focus on *enterprise value* as the sole determinant of materiality underlying their sustainability standards and recommendations (ISSB, 2022b), it is not surprising that the TCFD framework that focuses on the *impact of climate change on the firm* would form the backbone of these new standards and regulations. Following the ISSB's publication of their TCFD-aligned climate-related disclosure standard, the FSB considers the TCFD's mission to be complete and the FSB has thus transferred the TCFD responsibilities to the ISSB (IFRS Foundation, 2023).

coordinating national financial authorities and international standard-setting bodies as they work toward developing strong regulatory, supervisory and other financial sector policies…" (Financial Stability Board, 2021).

[2] For example, in his 2020, 2021, and 2022 letters to CEOs, Blackrock's Larry Fink asked all companies to report in alignment with the recommendations of the TCFD (Fink, 2020, 2021, 2022). In a statement to the Institute of International Finance on April 22nd, 2021, Janet Yellen endorsed the TCFD climate reporting framework (Yellen, 2021). In February 2020, Mark Carney declared that "Every major systemic bank, the world's largest insurers, its biggest pension funds and top asset managers are calling for the disclosure of climate-related financial risk through their support of the TCFD." Following its pledge to cut emissions by 40%-45% by 2030 and its commitment to net zero by 2050, on May 13th, 2021, the Government of Canada established the Sustainable Finance Action Council, indicating that the Council's "early emphasis will be on enhancing climate-related disclosures in Canada's private and public sector, in alignment with the TCFD recommendations" (Segal, 2021). In December 2020, the UK's Financial Conduct Authority issued a policy statement requiring companies with a UK premium listing to include a statement in their annual financial report whether their disclosures are consistent with TCFD recommendations (FCA, 2020). This is part of a broader roadmap to make TCFD-aligned disclosures mandatory in the UK by 2025 (HM Treasury, 2020).

The TCFD's reporting guidelines solicit the disclosure of climate-related risks, opportunities, and financial impact estimates. More specifically, the TCFD divides climate-related risks into two major categories: i) risks related to the *transition* to a lower-carbon economy; and ii) risks related to the *physical* impacts of climate change (TCFD, 2017, p. 5). *Transition* risks include regulatory and legal risks, such as the financial impact of carbon taxes or climate-related litigation (e.g., PG&E's triggering of California wildfires that resulted, in part, from a prolonged drought). Also included in this category are market risks (e.g., related to the supply and demand for commodities); technology risks, such as the development of renewable energy, battery storage, and energy efficiency; as well as reputational risks related to changes in consumer and societal preferences during the low carbon transition. *Physical risks* may be event driven (acute) or due to longer-term shifts (chronic) in climate patterns. An example of the latter is where an increase in global temperatures over time will result in a sea level rise that could eventually lead to asset submersion for companies owning real property in low-laying or coastal locations. Examples of acute risks include the increasing frequency and intensity of hurricanes affecting the Southeastern U.S., flooding in Bangladesh, Germany, China, and elsewhere, or the wildfires engulfing Australia and California. The TCFD also recognizes that there are climate-related *opportunities* related to resource efficiency, alternative energy sources, new low-emission products and services, new markets, and in developing resilience, and the framework explicitly attempts to elicit company-provided insights into both climate-related upsides as well as risks, and also calls for estimates of the financial impacts of these risks and opportunities on the firm.

To the best of our knowledge, the only large-scale global repository of corporate TCFD disclosures is that provided by the CDP, which consists of voluntary disclosures provided by companies in response to the CDP survey.[3] We use the CDP survey and response status data for companies headquartered in advanced economies from the inception of the TCFD framework's implementation in 2018 to 2022. Our sample consists of over 17,000 firm-year observations for 5,454 individual non-financial and non-real-estate firms headquartered in 26 different advanced economies. Of the surveyed firms included in our sample, 57.1% responded to the CDP's survey, with over 37% of surveyed firms providing disclosures related to the climate change risks that they're facing, and over 39% of firms identifying climate-related opportunities. The number of

[3] As we explain in greater detail in Section 2, the CDP (formerly known as the Carbon Disclosure Project) is an NGO that sends surveys to thousands of firms around the world every year, soliciting carbon emissions data and other firm-specific climate-related information.

companies in our sample providing TCFD-related disclosures in their CDP survey responses has grown steadily from 1,049 in 2018 to 1,931 in 2022, although this overall net growth in disclosers masks the fact that there is also a non-trivial amount of attrition – 259 active firms that provided TCFD information in one year failed to report on this information in the subsequent year.[4]

Our first set of investigations examine the determinants of firms' respective decisions to: i) respond to the CDP questionnaire; ii) identify physical and/or transition risks in accordance with the TCFD framework; iii) provide the TCFD-solicited estimates of the financial impact of the identified climate risks; and iv) identify climate change related opportunities available to the firm. Consistent with the results from prior (typically single-country) studies of firms' other environmental disclosure decisions (e.g., GHG emissions), we find that firm size and institutional ownership are both positively associated with the likelihood of CDP response and the provision of TCFD disclosures, while internally generated intangible assets and growth opportunities are positively associated only with the decision to respond to the CDP survey and to provide climate-related opportunities. We further find that less liquid and less profitable firms, those with higher levels of capital expenditures, and companies that are headquartered in countries with more freedom of expression, freedom of the press, and higher regulatory effectiveness are all more likely to voluntarily provide TCFD-compliant disclosures, while those with blockholders are less likely to be forthcoming. Indicators of the firm's overall commitment to sustainability, such as having a sustainability sub-committee of the board of directors, the establishment of an environmental management system, the production of a sustainability report, and overall environmental performance are each also incrementally significant determinants of firms' disclosure propensities across all decisions. Although we present this as descriptive evidence, the findings related to TCFD disclosures are new to our study and they are important because, as suggested by Christensen et al. (2021), "[o]bserved disclosure practices provide insights into when firms are more likely to find CSR reporting beneficial, which in turn can be useful in understanding which firms would likely be more or less affected by a mandate." Our findings thus provide insights on firm- and country-level characteristics that are likely to be associated

[4] Our large-sample-based observation that some previously TCFD disclosing firms no longer opt to report this information to the CDP echoes anecdotal accounts documented elsewhere (e.g., Metzner and Mikes, 2021) that companies are disinclined to continue their participation in the CDP surveys because the costs of doing so outweigh the expected benefits.

with the highest levels of transition costs and informational benefits when the various TCFD-based standards and regulations that are pending become mandatory.

We next examine the market implications of responding to the CDP survey, and separately the market implications of the more specific TCFD-compliant climate risk, opportunity, and financial impact disclosures. With respect to the CDP survey, firms that respond are evidently measuring and tracking important data related to CO2e emissions, climate-related business strategies, targets, risks, opportunities, and/or other aspects of performance for internal decision-making purposes. As such, the mere act of disclosing to the CDP may provide a signal to the capital markets that disclosing firms are more focused on, and/or adept at, *managing* climate-related issues, leading to a reduction in information risks about this facet of the firm's activities and thus to higher market values, ceteris paribus. Additionally, or alternatively, the CDP survey responses may convey specific information that helps to reduce shareholders' information risks about the firm's exposure to climate change risks and opportunities, which would also lead to higher firm value, ceteris paribus.

We find evidence consistent with CDP disclosure reducing information asymmetries; an indicator for firms responding to the CDP survey is reliably negatively associated with equity bid-ask spreads, except in the case of U.S. and Japanese firms. These findings are new to our study, and their importance is heightened because we additionally document that the CDP disclosure indicator is not reliably positively associated with market values. Specifically, the significance of the CDP indicator in balance sheet valuation models is not robust to the choice of scalar in valuation regressions (e.g., Barth & Clinch, 2009), to controlling for observable self-selection, and to other aspects of the empirical specifications.[5] We thus show that any positive valuation effect derived from improved transparency through a reduction in information asymmetries does not robustly translate into higher firm value. Taken together, our findings meaningfully expand our understanding of the impacts of climate-related disclosures as they suggest that, on average, CDP disclosures contain "bad" news that offsets the positive firm value effects of increased transparency.

Predictions related to the climate-related disclosures solicited by the TCFD framework are even less straightforward. Considering that managers primarily have incentives to talk up their

[5] Our findings for the CDP survey response broadly mirror those of Aswani et al. (2023) in the context of carbon emissions.

firm's share price (Baginski et al., 2016), the negative connotations implied by the firm's specific identification of material physical and transition risks and their financial impacts should make these risk disclosures inherently credible (i.e., at least as a lower bound on the firm's risk exposures). Thus, *a priori,* the test of value relevance for these risk disclosures could be considered a "straw man," with the refutation of the risk counts' value relevance being highly improbable, particularly in light of the extremely high level of support for TCFD-compliant disclosures in combination with the alleged investor demand for climate risk information. On the other hand, leading regulators, practitioners, and academics claim that climate risks are not being fully priced (Arnold, 2020; CFTC, 2020; International Monetary Fund, 2020; Schnabel, 2020), and specifically that there is a lack of awareness of, or appreciation for, the TCFD framework (Hook & Vincent, 2021; OMB Research, 2021). Ultimately, whether these disclosures are associated with market metrics for our global sample of firms remains an empirical question that we address with this study.

We first examine whether an indicator set to one when the firm volunteers the disclosure of any climate-related risks is informative to the capital markets. Across a multitude of alternative specifications that control for self-selection on observables and for factors correlated with both market measures and our disclosure metrics, we find only weak evidence that the indicator is associated with a reduction in firm value, and there is mixed evidence that the climate risk disclosure indicator is significant in explaining equity bid-ask spreads. We therefore extend our analyses to consider whether each of the number of physical risks and/or the number of transition risks disclosed by the firm are significant in explaining market values and/or bid-ask spreads. Market value regressions reveal that the number of *transition* risks disclosed by the firm explains the negative association between climate risk disclosure and value reduction. This negative impact of transition risks on firm value is consistent with their being viewed as unrecognized liabilities or as unrecorded asset impairments. By contrast, the number of *physical* risks disclosed is not associated with the firm's market capitalization. This latter finding may be explained by the likelihood that physical risks may be either insurable and/or diversifiable, whereas transition risks tend to be inherent in the firm's operations and more systemic in nature. The specific transition risks that exhibit the most economically and statistically significant negative association with market value are the number of reputation, legal, and regulatory risks identified by the firm, a

finding that is in line with survey evidence showing that institutional investors believe that climate-related regulatory risks have already materialized (Krueger et al., 2020).

Our final set of tests reveal some important limitations to the TCFD-solicited climate change information. First, the firm-provided *financial impact* estimates of the disclosed climate-related risks that are supposed to be useful to market participants are insignificant in both market value and bid-ask spread regressions. Their insignificant association with market metrics suggests that these estimates are either too noisy, and/or that they are considered to be of sufficiently low probability of occurrence or remote in time as to have a zero net impact on firm value. Alternatively, given the voluntary nature of these disclosures, their lack of prevalence across firms, the channel through which they're being disclosed, and claims that many investors are uninformed about the TCFD framework, it is possible that investors either don't understand the TCFD disclosures that firms are voluntarily furnishing to the CDP or that they are inattentive to this information due to its lack of salience.[6] Finally, we find that climate-related *opportunities* identified by CDP survey respondents are not associated with either market values or bid-ask spreads, consistent with these disclosures being viewed as "cheap talk" and/or with the disclosures being too vague or boilerplate as firms try to avoid providing detailed information related to as-yet-unrealized opportunities that could compromise their competitive advantage. Overall, and contrary to the notion that forthcoming global TCFD-based standards will serve as a panacea for the current lack of climate information available to capital markets participants, our study provides mixed evidence related to the market-relevance of voluntary TCFD disclosures currently being provided to the CDP.

Although caution must be exercised when attempting to draw inferences related to the expected results from mandating disclosures based upon studying existing voluntary disclosures (Christensen et al., 2021), the combined findings from our study nevertheless offer important insights related to the future of global climate-related reporting. First, our analyses of disclosure determinants identify the characteristics of firms that are likely to face more significant transition costs and benefits when the various TCFD-based disclosures become mandatory in different jurisdictions around the world. Second, we document that some TCFD information does appear to be credible and reflected in market metrics, even in its current voluntary and largely unaudited

[6] As discussed in the next section, the CDP questionnaire is well over 100 pages long during the years of our sample, and prior research shows that saliency is important to sustainability information being reflected in investors' decisions (e.g., Hartzmark and Sussman, 2019; Amel-Zadeh et al., 2022).

form, offering a solid endorsement to the standardization and mandating of these disclosures going forward. Importantly, however, we also identify some TCFD information that is potentially too noisy or otherwise insufficiently credible to be reflected in prices, factors that standard setters and regulators may wish to consider as the world moves towards the implementation stage of the forthcoming TCFD-based mandatory disclosures. Given that costs of disclosure are non-trivial, the potential net benefits from mandating TCFD-based disclosures, without some commensurate education to preparers and capital market participants to ensure that relevant and reliable disclosures are being provided and understood, would seem to be far from obvious.

2. Background and Related Literature

2.1 Background Information Related to Corporate Climate Reporting

Similar to the rest of the ESG reporting landscape of which it is a part, corporate climate-related reporting has been the subject of numerous alternative frameworks and reporting standards.[7] To address perceived weaknesses associated with existing all-purpose sustainability disclosure frameworks, a number of standard-setting organizations were established to focus on the most "pressing" element of the ESG agenda; namely, climate change (Barker & Eccles, 2020).

Founded in 2000, the Carbon Disclosure Project (later simply "CDP") was an early attempt to promote and gather corporate disclosures on climate-related issues. The CDP encourages companies to voluntarily disclose their impact on climate change, particularly by measuring, reporting, and setting reduction targets for their greenhouse gas ("GHG") emissions. The CDP relies on its investor signatories to request firms to be surveyed.[8] Criteria for inclusion in their survey sample are that the firm's securities are publicly traded, that the firms are amongst the

[7] The Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), the International Integrated Reporting Council (IIRC), the Climate Disclosure Standards Board (CDSB), as well as the UN Global Compact through its Principles for Responsible Investing initiative, all speak to climate risk disclosure issues in one way or another. The EU's Non-Financial Reporting Directive (NRFD), subsequently replaced by the EU Corporate Sustainability Reporting Directive (CSRD), is also important to this landscape, as are the Partnership for Carbon Accounting Financials (PCAF) and Glasgow Financial Alliance for Net Zero (GFANZ) for financial institutions. Barker and Eccles (2018) provide a more extensive review and discussion of the various ESG-related standard-setting agencies, although the landscape has evolved considerably since that time.

[8] The CDP's investor request process is described in greater detail on their website at https://www.cdp.net/en/investor/request-environmental-information#d52d69887a88f63e15931b5db2cbe80d (accessed May 6th, 2023). The CDP also surveys companies through its supply chain programme, but this data is not made available outside of a company's supply chain and is not further considered in this study.

largest firms in their country of headquarters (by market capitalization), and/or constituents of regional or stock market indices around the world, and/or have high GHG emissions, or they have previously responded to the CDP survey (i.e., a continuity criterion).[9] According to the CDP, more than 680 financial institutions with more than $130 trillion in assets have asked nearly 10,400 companies worth $105 trillion in market cap to disclose environmental data through the CDP.[10]

Initially focused on the company's *impact on the environment*, CDP disclosures are of interest to a wide variety of stakeholders, including shareholders.[11] Indeed, there is a significant body of academic research documenting the price-relevance of emissions disclosures to both equity (e.g., Clarkson et al., 2013; Matsumura et al., 2014; Bolton & Kacperczyk, 2021, amongst many others) and debt markets (e.g., Herbohn et al., 2019), although Aswani et al. (2023) question the validity of the inferences drawn from some of these studies.

From the perspective of analyzing the financial risks and opportunities that climate issues pose for a firm, however, such carbon emissions disclosures are necessary but not sufficient. A critical missing element from climate-related corporate disclosure frameworks that focus on *the firm's impact on the environment* and/or society is the disclosure of information related to the *impact of climate change on the firm.* The development of the TCFD framework was premised upon the assumption that a firm's identification and description of the material physical and transition risks that it faces, as well as their estimates of the financial impacts of climate risk, if credibly conveyed, would be informative, relevant, and necessary to decisions about the firm in equity, credit, and insurance markets.

Beginning in 2018, the CDP survey was expanded to include questions designed to elicit the information proposed by the TCFD framework. Survey participation is entirely voluntary, it is not directly tied to any country-specific legislation, and companies report that the survey is

[9] Further details related to the CDP's most recent survey procedure can be found at https://cdn.cdp.net/cdp-production/comfy/cms/files/files/000/007/601/original/CDP_sample_setting_methodology_climate_change_2023.pdf.

[10] https://www.cdp.net/en/articles/media/More-than-680-financial-institutions-call-on-nearly-10400-companies-to-disclose-environmental-data-through-CDP (accessed May 6th, 2023).

[11] Shareholders may be interested in the firm's CO_2e emissions because of the increase in carbon emissions tax and allowance schemes that may affect the firm's cost structure and viability, because of changing consumer preferences for more environmentally friendly products (potentially affecting each producer in the supply chain), because of changing financial capital providers' tastes favoring greener companies, or due to any other similar reasons that result in the firm's own CO_2e emissions potentially influencing the firm's financial prospects due to their importance to the firm's many stakeholders.

extremely time- and resource-intensive to complete. By way of example, the .pdf version of the CDP Climate Change Questionnaire for 2022 is 149 pages long. Corporate respondents complete the CDP survey via an online form that includes closed- and open-ended questions. The closing deadlines for responding to the survey have varied over the years, but generally fall between July and August. The CDP consolidates responses by late fall, after which time their data becomes available. Respondents can elect whether to make their responses available to the public or stipulate that the data remain "private." In the former case, an individual company's annual responses can be freely accessed on the CDP's website, while access to a complete dataset of corporate responses is available to the public (e.g., academics) only for a fee. In the latter case, however, even though the company chooses to have its responses remain "private," all of the CDP's investor signatories are given access to the company's responses. Current signatories would appear to include virtually all major money managers and institutional investors from around the world, so for all intents and purposes from a capital markets perspective this "private" information could be considered to be publicly-available.[12] For the 5 years covered by our study, of the 57.3% of firm-year surveys that yielded a response, 44.4% granted public access to their data and 12.9% requested that access be limited to signatories.[13]

2.2 Voluntary Disclosure Literature

Hahn et al. (2015) identify two complementary theoretical perspectives that explain disclosure decisions: sociopolitical theories of disclosure, and economic theories of (voluntary) disclosure. Sociopolitical theories (e.g., Gray et al., 1995) view disclosure as firms' response to social, political and stakeholder pressure, a perspective that suggests that climate-related disclosure can be explained as a response to stakeholder demand for information about how climate change affects the firm. Previous studies that explain *climate-related disclosure* in these terms include Liesen et al. (2015) in a European setting, Ding et al., (2023) in a cross-country

[12] A listing of capital market signatories to the CDP's 2023 request for data is available at: https://cdn.cdp.net/cdp-production/comfy/cms/files/files/000/007/621/original/CDP_Investor_Signatories_2023.pdf, with the benefits and process for becoming a signatory summarized here: https://www.cdp.net/en/investor/signatories-and-members?anchor=st_member__block_section&page=1&per_page=all (accessed May 6th, 2023).

[13] Given that hundreds of institutional investors from around the world will have access to their responses, the corporate decision to have the CDP information withheld from all of the firm's other (non-capital markets) stakeholders is rather puzzling. In Table 1 of the online appendix, we investigate the determinants of this decision. We find that private CDP respondents are significantly smaller and have lower levels of institutional ownership than those that make their responses publicly available. See Ott et al. (2017) for a more comprehensive discussion of the decision to disclose publicly versus privately to the CDP.

context, and Reid and Toffel (2009) and Cho and Patten (2007) in the U.S. context. Also consistent with the sociopolitical perspective, countries with higher corporate governance and disclosure norms have been shown to exert higher pressure for carbon disclosure (Choi & Luo, 2021).

Economics-based theories of disclosure, while acknowledging the forces of institutional pressure, also argue that companies will undertake a cost-benefit analysis before opting for voluntary reporting (e.g., Verrecchia, 1983). This perspective recognizes that demand for discretionary disclosure of corporate information arises from the inevitable information asymmetry that exists between corporate insiders and the firm's other stakeholders, and suggests that firms will optimize their disclosure policy in a manner that maximizes firm *value*.[14] This more narrow perspective fails to consider agents' broader mandate of maximizing shareholder *welfare*, however, which is not necessarily synonymous with shareholder *value* (Christensen et al., 2021; Hart & Zingales, 2017), and the differences are likely to be considerably more important in the context of sustainability-related disclosure decisions. Nevertheless, while it is still reasonable to assume that corporate environmental disclosure decisions will involve a rational cost-benefit analysis, the decisions about whether to disclose climate risk information are complicated by a lack of consensus (and knowledge) about how to measure these risks, and whether they are likely to be credible and material to decision makers, given that climate change predictions are generally uncertain and involve very long time horizons (Christophers, 2019).

The costs of disclosure in general include the potential release of proprietary information, the establishment of a measurement, tracking, and reporting system, and perhaps the additional need to have the disclosures assured by an independent third party to render them more credible. In the environmental realm, foreseeable costs also include potential negative reputational costs if the firm is not perceived to be performing in line with stakeholder expectations (e.g., loss of access to/retention of talented employees, loss of sales or higher costs to maintain the same level of sales, higher costs of financial capital, etc.), in addition to the possible costs that could arise from the firm being targeted by activist campaigns (shareholders, customers, or the general public) and/or government agencies, including through the introduction of new regulations.

[14] Healy and Palepu (2001) and Beyer et al. (2010) provide comprehensive and insightful summaries of the disclosure-related literature, however Christensen et al. (2021) caution that corporate social responsibility (or sustainability) reporting differs from financial reporting in a number of very important ways.

2.3 The Relevance of Climate-Related Disclosures to Financial Markets

2.3.1 Signalling and Information Asymmetry Reduction Through the Act of Disclosure

Disclosure of private information reduces information asymmetry between firm insiders and the providers of capital (Healy & Palepu, 2001). Whether it is good or bad news that is being released, the provision of information reduces uncertainty and is expected to lead to a lower cost of capital, ceteris paribus. Consistent with this, using a sample of U.S. firms, Dhaliwal et al. (2011) find that the initiation of CSR reporting results in a lower cost of capital.

With respect to carbon and climate risk disclosures, signalling theory (e.g., Milgrom, 1981; Connelly et al., 2010) would suggest that a firm that discloses its carbon emissions and/or climate risks is signalling not only its ability to measure these emissions and risk exposures, a prerequisite for managing them (Matsumura et al., 2014), but also its superior performance (Clarkson et al., 2008). Moreover, climate-related disclosures provide investors with information about potential future costs that firms may incur due to changes in regulations, consumer preferences, or market dynamics triggered by societal efforts to mitigate climate change. Being able to readily access this information, investors do not need to undertake costly information searches such as purchasing (potentially very noisy) estimates of firms' carbon emissions from third party providers.

In line with these arguments, prior research finds that firms disclosing their carbon emissions enjoy higher firm valuations and a lower cost of capital relative to non-disclosing firms. Employing propensity score matching and doubly robust regressions, Matsumura et al. (2014) document that median firm value is $2.3 billion higher for S&P 500 firms with disclosed carbon emissions compared to firms without emissions disclosures. This is consistent with Bolton and Kacperczyk's (2021) finding that the voluntary disclosure of Scope 1 GHG emissions is associated with lower stock returns.

Recent studies have extended the scope of this research from considering the capital market implications of emissions disclosures to examining the consequences of providing information about climate change exposure more broadly. Studying a sample of 717 European companies, Schiemann and Sakhel (2019) document that the voluntary disclosure of firms' exposure to physical climate risks is associated with lower information asymmetry. Flammer et al., (2021) conduct an event study of U.S. S&P 500 companies disclosing climate risks through the CDP questionnaire after being targeted by environmental shareholder activists. Assessing the stock

market response around the day on which the climate risk disclosure is released to the public, the study finds that companies disclosing climate risks achieve higher stock market valuations post-disclosure.

Following from both information asymmetry and signalling theories, as well as the prior empirical environmental disclosure literature, we similarly expect that, in the context of our international sample of firms and their decisions related to CDP questionnaire response, as well as the disclosure of TCFD-solicited climate risk information, the act of voluntary disclosure will lead to a higher market value, ceteris paribus.

2.3.2 Information Content of Climate-Related Disclosures

A considerable body of prior research has investigated the association between firm value and *the disclosed levels,* or *amounts,* of environmental issues, rather than the *act of disclosure* itself. Beginning with Barth and McNichols (1994), the early literature examined the capital market implications of corporate environmental issues through the lens of unbooked liabilities (i.e., firms' exposure to potential future costs arising from environmental regulations). This strand of literature has found that the exposures to such environmental liabilities are associated with lower firm value (Barth & McNichols, 1994; Cormier & Magnan, 1997; Hughes, 2000). Much of the subsequent literature examining the value-relevance of carbon emissions as a proxy for environmental obligations has adopted a similar framework, hypothesizing and finding that the amount of carbon emissions are negatively associated with firm value (Chapple et al., 2013; Choi & Luo, 2021; Clarkson et al., 2015; Griffin et al., 2017; Matsumura et al., 2014). Although the basic finding of a negative relation between emissions and firm value is consistent across most studies, the economic significance of this relation differs between geographies and time periods, and results are sensitive to how emissions are measured (Aswani et al., 2023).[15] Consistent with this, Clarkson et al. (2015) find that for firms that are subject to the European Emission Trading Scheme, only those carbon emissions that are not covered by free emission allowances are associated with a valuation penalty, which they estimate to be €75 per ton of

[15] For example, Matsumura et al. (2014) use an unscaled measure of total Scope 1 and Scope 2 GHG emissions for a sample of U.S. firms and find that every additional ton of emitted carbon is associated with a $212 reduction in firm value for S&P 500 companies. Studying the same empirical setting, but scaling carbon emissions by shares, Griffin et al. (2017) report a market-implied equity discount of $78.8 per ton of carbon emissions for the median S&P 500 company in their sample. Using a sample of 58 Australian firms, Chapple et al. (2013) document a 6.57% valuation penalty for firms with high relative to low carbon intensity, defined as GHG emissions scaled by sales revenue.

emissions. Similarly, using a global sample of 1,748 firm-year observations from 28 countries, Choi and Luo (2021) find that the negative association between carbon emissions and firm value is stronger in the presence of a national emissions trading scheme. Bolton and Kacperczyk (2022) also document some cross-country differences in the pricing of firms' carbon emissions, but overall they find a consistent, positive association between carbon emissions and stock returns for firms in all sectors across three continents (Asia, Europe, North America). Hsu et al. (2023) further show that there is also a positive association between toxic emissions and stock returns for a sample of US firms. All these findings of a negative association between emissions levels and firm value are consistent with the notion that these disclosures capture imposing threats of regulation and/or other expected real costs as the economy transitions to a lower carbon reality.

Notably, all the preceding studies examine the association of firm performance, returns, and/or value with a measure of *the firm's impact on the environment* (i.e., emissions), which is at best an indirect and incomplete measure of the potential cost to shareholder value associated with climate change. Considering the body of evidence supporting the value relevance of such a weak proxy for the total climate risks being faced by the firm, it seems reasonable to expect that the "gold standard" TCFD disclosures that we examine, which are designed to measure the more shareholder relevant *impacts of climate change on the firm*, would quite obviously be associated with firm value.

Supporting this perspective, Sautner et al. (2023) and Berkman et al. (2022) find that broader 10-K and earnings-call based measures of firm-specific climate change exposure are negatively priced in equity markets. Kölbel et al. (2022) use a textual analysis of U.S. firms' 10-K reports to investigate whether the corporate climate risks disclosed in these filings are priced by the credit default swap (CDS) market. Differentiating between physical and transition risks, as suggested by the TCFD framework, the authors find that transition risks increase CDS spreads, especially after the Paris Climate Agreement of 2015, but they do not find any such significant effect for physical risks. Li et al. (2024) similarly show that earnings-call based measures of *transition* risks, but not physical risks, are negatively priced after 2010, and Matsumura et al. (2022) further suggest that the materiality of climate risks moderates the association between climate-risk disclosure and cost of equity. To the best of our knowledge, however, there is no corresponding evidence specifically focusing on the full set of TCFD-aligned climate-related risks, opportunities, and financial impact disclosures for a global sample of firms, and we note

that earnings-call based measures are likely to contain discussions of recent and salient developments only, instead of discussions of more fundamental long-term risks stemming from the effects of climate change on the firm.

For several reasons, there is considerable tension underlying the expected market-relevance of TCFD disclosures. First, and of direct relevance to the TCFD compliant disclosures that we investigate, Aswani et al. (2023) find that emissions are only associated with returns when emissions data are estimated by data purveyors, *not when the disclosures emanate from the firm*, and further that emissions are not associated with performance when the analyses incorporate industry effects. Consistent with the source of climate-related information being relevant, Depoers et al. (2016) show, in the context of French listed firms, that greenhouse gas emissions reported in corporate reports are significantly lower than those reported to the CDP.

Second, anecdotal accounts stemming from representatives of leading organizations around the world suggest that climate change issues more broadly (i.e., beyond CO_2e emissions) are not being adequately priced by the capital markets. For example, BNY Mellon (2019) reports that 93% of survey participants "regard climate change as an investment 'risk' that has yet to be priced in by all the key financial markets globally." The IMF similarly reports that climate change physical risk does not appear to be reflected in global equity valuations, leading the organization to call for global mandatory disclosures on material climate change risk (International Monetary Fund, 2020). The U.S. Commodity Futures Trading Commission (CFTC) has arrived at similar conclusions, claiming that, "in the case of climate risk, neither the expected impacts – nor the potential for extremely bad outcomes – is being priced appropriately" (CFTC, 2020). Christine Lagarde, President of the European Central Bank, has expressed a similar opinion in the international arena (Arnold, 2020). Consistent with these mostly anecdotal perspectives, a recent survey of academics, professionals, and public sector regulators and policy economists reports that, "[b]y an overwhelming margin, respondents believe that asset prices underestimate climate risks" (Stroebel & Wurgler, 2021, p. 1). With respect to TCFD disclosures in particular, a GSIA (2019, p. 5) investor poll reports that "87% said they do not believe that markets are consistently and correctly pricing climate risks into company and sector valuations."[16]

[16] Further survey evidence supports these findings. For example, an HSBC survey of 2,000 investors found that just 10 per cent of respondents viewed TCFD disclosures as a relevant source of information, claiming, "[d]espite all the talk about TCFD, at the moment we don't see it being used in discussions with credit rating agencies, in discussion

In summary, there is conflicting evidence related to the value-relevance of the more pervasive and generally well-understood corporate carbon emissions disclosures. Combined with the many anecdotes and survey evidence suggesting that TCFD disclosures are either not well understood or not being attended to by investors, and notwithstanding the unanimously strong support for the TCFD framework on the part of many regulatory bodies and other important players in the global capital markets, the extent to which this alleged "gold standard" of climate risk reporting will be reflected in market prices is far from obvious.

3. Data, Sample, and Research Design

3.1 Data

Data related to corporate voluntary reporting of TCFD-related climate disclosures was purchased from the CDP. We use data for the reporting years 2018 through 2022 (i.e., the years for which the CDP solicited TCFD-compliant disclosures).[17] The CDP claims to do some light review of the company-furnished data, but none of the submissions are required to be audited, nor are they apparently subject to serious scrutiny before being consolidated by the CDP and made accessible on their website or sold in database form. Our review of the TCFD-related responses concerning the financial impacts of climate risks suggests that this CDP data cannot be taken at face value. As a consequence, we undertook a detailed algorithmic assessment of the financial impact of climate risks and financial impacts of climate change opportunities disclosures made by

with mainstream investors — it is still a very niche agenda item" (Hook & Vincent, 2021). In the U.K., where legislation is now in place to *mandate* TCFD-compliant corporate climate risk disclosures by 2025, a recent survey of defined benefit (DB) pension plan managers prepared for The Pensions Regulator found that less than 50% of all DB schemes allocated time and resources to assessing any financial risks and opportunities associated with climate change (although the proportion was 70% for large schemes), and that fully 71% of respondents (including 59% of large DB scheme respondents) were not even aware of the TCFD (OMB Research, 2021).

[17] The CDP labels their data based on the year in which the company *reports* the climate related information. The deadline by which companies are required to respond to the survey has varied from July to August, and thus for most companies a "2018" CDP reporting year corresponds to the company's 2017 fiscal year. Worldscope mostly classifies fiscal years as the calendar year in which the fiscal year ended, except for a short period after the calendar year end. To align CDP data with financial data, we assume that companies with fiscal year end months of January through June that are reporting to the CDP in 2018, e.g., are reporting for their fiscal year 2018, while companies with year ends from July through December that are reporting in 2018 are reporting for their fiscal year ending in 2017. For the latter group (i.e., the majority of companies in the sample), we merge the 2018 CDP data to their 2017 financial data and refer to this as a "2018" observation because this is the year of the climate risk disclosure decision. Our results are not sensitive to alternatively assuming that only companies with year ends from January to March file CDP reports in the year that corresponds with their fiscal year end (which is not surprising given that relatively few firms in the sample have year ends from April through June, and also given that many of the explanatory variables are "sticky" from year to year).

the firm-years included our sample.[18] In the absence of alternative sources of tabulated data for these disclosures against which we could verify the CDP submissions, our review was limited to checking the internal consistency between the quantitative financial impact figures and the textual explanations provided to the CDP (i.e., disclosures made within the same survey). The details of this procedure are provided in Appendix A. Overall, out of 16,188 financial impacts of climate risk observations, we identify a total of 6,184 (38.2%) to be potentially problematic and a further 2,325 (14.36%) to be suspect, as summarized in Figure A1. Similarly, out of 14,236 non-missing financial impacts of opportunities, we identify 4,913 (34.5%) to be potentially problematic and a further 1,933 (13.6%) to be suspect, as summarized in Figure A2. In the financial impact estimate analyses that follow, we start with models that include all financial impact estimates, and then iteratively drop suspect observations and the various categories of potentially problematic observations to mitigate the possibility that our financial impact estimate results are caused by noisy and/or erroneous reporting. We caution all users of the CDP database to do likewise.

Company financial data and capital markets data are from Worldscope and Datastream, respectively. Data on ESG ratings, institutional ownership, and firm-specific environmental and governance variables are obtained from Refinitiv EIKON. Data on earnings call-based measures of firm-specific climate exposure are from Sautner et al. (2023)[19], and we obtain data on country-level institutional features from several sources including the World Bank, as described in further detail in Appendix B.

3.2 Sample

Our sample consists of non-financial and non-real estate companies headquartered in advanced economies as identified in the IMF's World Economic Outlook report (International Monetary Fund, 2022).[20] Table 1 describes our sample selection process. We begin with the

[18] The unit of observation for the data verification is the climate risk financial impact disclosure or the climate change opportunity disclosure, of which there may be several per firm per year.
[19] We thank Sautner et al. (2023) for making their data publicly available at: https://doi.org/10.17605/OSF.IO/FD6JQ.
[20] Financial firms are excluded from our sample because they are subject to significant international regulation and other voluntary climate disclosure regimes such as the PCAF and GFANZ. We also drop real estate firms, which, like financial firms, are economically very different from the firms retained in our sample (e.g., many of the performance and financial structure measures included as controls in our regressions are subject to different interpretations in the context of financial and real estate firms), so it would not be appropriate to include them in pooled regressions.

listing of firms to which the CDP sent survey requests for each year in our sample, as described in the previous section. Specifically, we use the CDP's *Climate Change Response Status* database. After dropping observations without ISINs, duplicate observations, those for which financial information is not available, and firms from countries with less than 20 total observations or less than 10 CDP responses, we are left with 17,272 firm-year observations for companies with publicly-listed equity.

3.3 Research Design

In order to investigate the determinants and capital-market consequences of TCFD-related disclosures, we first estimate determinants models for the decision to disclose to the CDP, and separately, for the decision to report TCFD-related information relating to climate risks, opportunities, and financial impacts. To account for self-selection in the estimation of TCFD-related capital market effects (i.e., firms self-select into responding to the CDP survey while we observe the full set of firms that were asked to respond to the CDP survey), we employ two-step Heckman selection models (Heckman, 1979) using the CDP disclosure decision model as the first-stage selection model and alternatively use entropy balanced regressions (e.g., McMullin & Schonberger, 2020; 2022).

As pointed out by Lennox et al. (2012) and Matsumura et al. (2014), Heckman selection models require that the exclusion restriction is satisfied. That is, there needs to be at least one variable in the first-stage model that is excluded from the second-stage model and conceptually unrelated to the second stage dependent variable. To satisfy this condition, we follow Matsumura et al. (2014) and include the Fama-French 48 industry-year propensity of CDP disclosure and the percentage of foreign sales in our first-stage models, which are arguably uncorrelated with firm-specific market valuations and bid-ask spreads.

Lennox et al. (2012) further point out that Heckman selection models are highly sensitive to slight changes in model specification and generally suffer from multicollinearity issues. We address concerns surrounding the validity of our Heckman model estimates in three ways. First, we estimate limited information (i.e., two-step consistent) models instead of the more efficient but potentially more fragile Full Information Maximum Likelihood variants.[21] Second, and

[21] Efficiency is less of a concern in our setting because our global sample should provide sufficient statistical power even when considering the reduced *effective* sample size with standard errors clustered by firm.

further to addressing potential multicollinearity issues while being cognizant of selection effects and correlated variables that may confound our inferences, we alternatively employ entropy balancing on our full set of first-stage CDP disclosure determinants and estimate all of our specifications with OLS on the balanced sample.[22] Specifically, we require the variances and means of our first-stage disclosure variables to be balanced across the CDP survey respondent and non-respondent groups and allow for variation in weights over time by generating weights within disclosure years (McMullin & Schonberger, 2022).[23] Third, we estimate and transparently report on a host of empirical specifications, employing both parsimonious models without fixed effects and more fully specified models. We draw our inferences from the full set of specifications, mitigating the possibility that any single fragile result affects our conclusions.

We base our inferences on Heckman's (1979) two-step standard errors for our selection models, and on cluster-robust standard errors at the firm-level in our entropy balanced and probit models. We truncate institutional ownership at 100% and winsorize all other continuous variables at the 1st and 99th percentile. All variables are defined in Appendix C.

3.3.1 Determinants models

To investigate the firm- and country-level determinants of firms' climate-related disclosure decisions, as well as to specify our first-stage regression model, we estimate variants of the following probit models:

[22] There are several benefits to using entropy balancing over other sample matching techniques and over Heckman models. First, in contrast to Heckman (1979) specifications, entropy balancing does not require that the exclusion restriction holds but instead assigns weights to the non-respondent group to make them comparable to the respondents on all specified observables and statistical moments. Second, entropy balancing allows for non-linear differences between the treatment and control group. Third, and in contrast to propensity score matching or exact matching that prune the sample, entropy balancing retains the full sample size.

[23] McMullin & Schonberger (2022) further point out that some observations may be assigned excessive weights to achieve covariate balance. The maximum weight in our control sample is 46, implying that the most influential control observation effectively serves as a control for only 46/9857*100 = 0.46% of CDP respondents. We further calculate that 37% of non-CDP respondents receive weights > 1, implying that a substantial part of our control sample is upweighted. These statistics notwithstanding, we also confirm that our entropy-balanced inferences are unchanged when dropping the 1% of control observations that receive the highest weight and re-estimating the weights on the sample without the most influential observations.

$$
\begin{aligned}
Disclose_{it} = \beta_0 + \beta_1 logSales_{it} + \beta_2 ForeignSales_{it} + \beta_3 IndPropDisc_{jt} + \beta_4 Cash_{it} \\
+ \beta_5 ROA_{it} + \beta_6 Loss_{it} + \beta_7 BTM_{it} + \beta_8 LEV_{it} + \beta_9 CapEx_{it} + \beta_{10} PPE_{it} \\
+ \beta_{11} IntangStock_{it} + \beta_{12} IntangBS_{it} + \beta_{13} InstOwn_{it} + \beta_{14} Block_{it} \\
+ \beta_{15} GDP_{ct} + \beta_{16} F1RegQual_{ct} + \beta_{17} F2Cultural_{ct} + \beta_{18} F3Freedom_{ct} \\
+ \sum_{j=1}^{43} \delta_j FFIndustry_j + \sum_{t=1}^{4} \gamma_t Year_t + \epsilon_{it} \qquad (1)
\end{aligned}
$$

where $Disclose_{it}$ is alternatively an indicator set to one if firm *i* in period *t* chooses to respond to the CDP survey (*CDP),* to provide TCFD-compliant climate risk information (*CR),* financial impact estimates (*FI),* or climate-related opportunities (*Opp)*, and zero otherwise.

Our candidate determinant variables are based on prior studies establishing that the firm's size, Fama-French 48 industry-year propensity for responding to the CDP survey, growth prospects, leverage, and capital intensity are all related to firms' environmental disclosure decisions (e.g., Clarkson et al., 2008; Matsumura et al., 2014; Liesen et al., 2015; Berkman et al., 2022). Firms that are more profitable are expected to have the resources and managerial attention required to implement the management information systems to track environmental performance metrics, and prior findings document that profitability is positively related to the voluntary disclosure of carbon emissions, although Berkman et al. (2022) find that earnings are negatively associated with the probability of disclosure. Our analyses also consider the firm's liquidity (*Cash),* as well as the potential role of investments in acquired intangible assets (*IntangBS*) and internally-generated intangible assets (*IntangStock)* (e.g., Demers et al., 2021) as some pundits consider these to be intimately related (albeit in unspecified ways) to the firm's sustainability activities and/or performance.[24]

Climate-related disclosures have been shown to be positively associated with institutional ownership (Ilhan et al., 2023; Krueger et al., 2020), while ownership by institutions that are also CDP signatories further increases firms' propensities to disclose to the CDP (Cohen et al., 2023). Blockholders, in turn, have been found to have a disclosure-decreasing influence as firms with

[24] To ensure consistency in measurement across variables (i.e., no double-counting or omissions), all accounting-based variables are adjusted for the capitalization and amortization of internally-generated intangible assets. We report results for "plain vanilla" models that use as-reported accounting variables (i.e., without notional capitalization of expenditures on intangibles) in the tables in the online appendix.

closely-held ownership are unlikely to be responsive to public investors' demands for information given that controlling shareholders already have access to the relevant data (Cormier & Magnan, 1999).

Following the international sustainability literature that considers country-level features (e.g., Ioannou & Serafeim, 2012; Dyck et al., 2019), we include principal-component factors that capture country-level characteristics such as the effectiveness of regulation (*F1ReqQual)*, cultural norms related to individualism and long-term orientation (*F2Cultural)*, and freedom of expression (*F3Freedom).* The data sources and estimations of these factors are described in detail in Appendix B. We also control for annual GDP per capita in USD purchasing power parity terms (*GDP*).

In separate analyses, we additionally consider sustainability- and governance-related variables, including a firm's signatory status to the UN Global Compact, the percentage of independent directors, whether the firm has an environmental management system, sustainability committee, or produces a sustainability report. As one would expect, the existence of a sustainability committee at the board level and the measurement and management of climate-related information (i.e., *EMS)* have each been found to result in a higher likelihood of environmental disclosure (Jaggi et al., 2018; Ott et al., 2017). Firms' prior CSR reporting has similarly been found to be positively associated with CDP disclosure (Banerjee et al., 2023). Predictions for independent directors are less straightforward. For example, Khoo et al. (2022) show that the relation between independent directors and CSR performance is contingent on the director's labor market reputational incentives.

3.3.2 Valuation models

In order to investigate the valuation effects of disclosing to the CDP, and specifically of disclosing TCFD-compliant climate-related information, we estimate balance sheet valuation models (e.g., Barth & McNichols, 1994; Matsumura et al., 2014).[25] We estimate all market-based models using TCFD-related disclosures jointly with equation (1) (Heckman, 1979) or with entropy balanced samples using the equation (1) variables. Specifically, our valuation models are variants of:

[25] We report the results from alternatively using Ohlson (1995) models and share-deflated valuation models in the coefficient plots discussed below.

$$MVE_{it} = \beta_0 + \beta_1 Disclosure_{it} + \beta_2 Asset_{it} + \beta_3 Liab_{it} + \beta_4 OpInc_{it} + \beta_5 F1RegQual_{ct} + \beta_6 F2Cultural_{ct} + \beta_7 F3Freedom_{ct} + \beta_8 EnvScore_{it} + \beta_9 logCO2e_{it} + \beta_{10} CCExposure_{it} + \sum_{j=1}^{43} \delta_j FFIndustry_j + \sum_{t=1}^{4} \gamma_t Year_t + \epsilon_{it} \quad (2)$$

where MVE_{it} is the firm's market value of equity in millions of USD at the end of the calendar year (Matsumura et al., 2014), and $Disclosure_{it}$ is alternatively an indicator variable taking the value of one if a firm reports to the CDP (*CDP)* and zero otherwise, an indicator taking the value of one if a firm reports climate-related risks (*CR)* and zero otherwise*,* the industry-year adjusted number of physical risks (*NPhysRisk_IA)* or transition risks (*NTransRisk_IA)* disclosed*,* the number of disclosed climate-related opportunities (*NOpportunity_IA)*, or the aggregate estimated financial impacts of disclosed climate-related risks or opportunities in millions of USD (*FIEstimateRisk and FIEstimateOpp,* respectively*).* We transform the number of climate-related risks and opportunities into industry-year adjusted measures to account for cross-temporal changes in disclosure characteristics as well as industry-specific differences in the relevance of climate-related transition and physical risks, and opportunities. All financial variables are measured at the end of the fiscal year to which the disclosures relate.

Next to the inclusion of total assets, liabilities, and operating income, our full valuation models control for country-based principal-component factors that potentially correlate with both market values and the propensity for TCFD-related disclosure, as well as for proxies for the firm's general level of environmental disclosure, environmental performance, and climate risk exposure, including the Refinitiv environmental pillar score that prior studies suggest captures disclosure more than impact (Drempetic et al., 2020; Raghunandan & Rajgopal, 2022), a climate change exposure measure derived from firms' discussions of climate issues during their quarterly conference calls (Sautner et al., 2023), and the firms' log-transformed CO2-equivalent Scope 1 and Scope 2 emissions (*logCO2e).*[26] Following Matsumura et al. (2014) and Barth and Clinch's

[26] In order to retain our full sample when including these additional controls, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure*, respectively, as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Each of the explanatory variables, except for BTM, are significant in all three models, and the explanatory power of the models are as follows: *adj-*R^2=50% for *CCExposure, adj-*R^2=40% for *logCO2e,* and *adj-*R^2=60% for *EnvScore*. The full tabulated results for each estimation are provided in the online appendix, and the coefficient plots included in the paper present the results of all analyses with and without these additional control variables.

(2009) findings that unscaled valuation models are the least biased, we do not scale the valuation model variables in our main analyses.

3.3.3 Bid-ask spreads

In our final set of analyses, we consider whether the provision of TCFD-solicited disclosures is associated with the firm's bid-ask spreads. Specifically, we estimate variants of the following models, using the Heckman correction or entropy balanced samples when any of the TCFD-related variables are included as the primary variable of interest:

$$\begin{aligned} BidAsk_{it} = {} & \beta_0 + \beta_1 Disclosure_{it} + \beta_2 logMVE_{it} + \beta_3 logRetVar_{it-1} \\ & + \beta_4 logShareTurn_{it-1} + \beta_5 BTM_{it} + \beta_6 ROA_{it} + \beta_7 Loss_{it} + \beta_8 IntangStock_{it} \\ & + \beta_9 InstOwn_{it} + \beta_{10} Block_{it} + \beta_{11} F1RegQual_{ct} + \beta_{12} F2Cultural_{ct} \\ & + \beta_{13} F3Freedom_{ct} + \beta_{14} EnvScore_{it} + \beta_{15} logCO2e_{it} + \beta_{16} CCExposure_{it} \\ & + \sum_{j=1}^{43} \delta_j FFIndustry_j + \sum_{t=1}^{4} \gamma_t Year_t + \epsilon_{it} \end{aligned} \quad (3)$$

Following Lang et al. (2012) and Daske et al. (2013), *BidAsk* is the median bid-ask spread scaled by the average of the bid-ask prices, *logRetVar* and *logShareTurn* are the log-transformed calendar-year lagged standard deviations of monthly stock returns and the aggregate amount of shares traded scaled by market cap in USD, respectively, and all three variables are measured over the CDP disclosure year. We further follow Lang et al. (2012) and include *logMVE, BTM,* and *Loss* as explanatory variables. We additionally control for firm-specific business model differences relating to internally generated intangibles with *IntangStock* and include variables relating to a firm's ownership *(InstOwn* and *Block)* because each may conceptually be related to both information asymmetry and the propensity to provide climate-related disclosures. All other variables are as previously defined.

4. Empirical Results

4.1 Descriptive Statistics

Table 2 provides descriptive information about the demography, industry affiliations, and respective average response rates for the firms included in our sample. Panel A reports the total number of publicly-traded firms surveyed by the CDP by country of headquarters for each of the

five CDP reporting years for which TCFD-related questions were included in the CDP's survey. The greatest number of surveyed companies are headquartered in Japan, followed by the U.S., the U.K., South Korea, and France. Companies headquartered in the G7 countries account for approximately 2/3 of the total firm-year surveys across the years shown, while nearly 80% of surveyed firms are headquartered in either the EU or G7 countries.[27]

Panel B provides response rates by country and by year, where firms are coded as responding if they respond to the CDP survey at all (i.e., whether they allow their responses to be made publicly available or request that their responses remain private). Not surprisingly, many of the higher responding countries are continental European, although surveyed companies in the U.K. and Taiwan are also very responsive. Commensurate with the expansion of the base of firms surveyed, response rates for Japan and the U.S. dropped significantly in the most recent year – i.e., many of the firms surveyed for the first time apparently did not respond. This largely explains the significant annual decline in the overall response rate from 62.5% in 2021 to 60.6% in 2022. Excluding Japan and the U.S., the response rate increased from 56% to 59.8% in the most recent year.

Panels C and D, respectively, provide the distribution of surveyed firms and their response rates by industry sector for each year. As shown, business equipment, manufacturing, and wholesale/retail services are the most surveyed firms, whereas chemicals, consumer durables, and utilities firms exhibit the highest response rates.

Panels E and F, respectively, provide the response rates by country and by industry for companies volunteering information solicited under the TCFD framework. Specifically, respondents include firms that provide information related to either climate-related risks or opportunities. Similar to their higher propensities to disclose to the CDP more generally, firms headquartered in many of the (Northern) European countries and/or operating in the chemicals and utilities industries exhibit higher propensities to provide TCFD-related disclosures, while US and Canadian firms also show above average TCFD disclosure propensities. Notably, however, the overall response rate to the TCFD-solicited questions that are a part of the CDP survey is a full 17% lower than the overall response rate to the survey.

[27] As is evident, the CDP significantly increased the number of Japanese and U.S. firms surveyed in 2022. The Japan sample was expanded from a narrower focus on "high climate impact firms" to include Tokyo Stock Exchange Prime Market firms, while the U.S. sample was expanded to include more MSCI Small Cap stocks than had previously been surveyed.

Table 3 provides descriptive statistics for all variables used in our disclosure decisions and capital markets regressions. The overall response rate to the CDP survey for the 5 years included in our sample was 57.1%, consisting of 44.2% of surveyed firms that were willing to make their responses public, and 12.9% of firms requesting that their responses remain "private" (i.e., only accessible to the CDP investor signatories). In terms of TCFD-related disclosures, 37.1% of firms offer disclosures related to climate risks (*CR*), while 29% provide estimates of the financial impacts (*FI*) of these climate risks. Surprisingly, 39.2% of firms disclose climate change related opportunities (*Opp*), indicating that the TCFD framework elicits a slightly higher incidence of good news opportunities relative to "bad news" threats related to climate change.[28] Conditional on providing any form of climate risk information (i.e., for firms for which *CR* = 1), untabulated analyses indicate that the average firm identifies 1.4 physical risks and 2.3 transition risks. The average firm further identifies 3.1 climate-related opportunities conditional on disclosing any opportunities. In further untabulated analyses that also incorporate data from the years prior to the CDP survey becoming TCFD compliant in 2018, we find that the number of disclosed risks and opportunities *conditional on any climate risk or opportunity disclosure* drops monotonically from approximately 6 each in 2010 to about 3 each in 2022. That is, firms disclose fewer risks and opportunities over time while the level of detail requested for each risk and opportunity disclosure increases. *Conditional* upon providing financial impacts of climate risk (i.e., for firms for which *FI* = 1), untabulated analyses indicate that the average firm-year estimate is 667 million USD, or a material 7% of sales when considering all disclosed financial impacts (i.e., prior to dropping suspect observations). Similarly, conditional upon providing any financial impacts of climate opportunities, the average firm-year estimate is 1,533 million USD, or a highly material 14.9% of sales.[29]

The Pearson and Spearman rank correlations in Panels A and B of Table 4 provide preliminary evidence that the likelihood of firms responding to the CDP questionnaire (*CDP*=1), disclosing climate risks (*CR=1*), and disclosing the financial impacts of climate related risks (*FI*)

[28] Given the high rate of opportunity disclosures under the TCFD framework, it is worth noting that generic material *risk* disclosure regulations such as those required of U.S.-listed firms in their 10-K filings would likely not elicit these upside disclosures.

[29] When suspect and problematic financial impact estimates are dropped, the average impact expressed as a percentage of sales declines (e.g., to 6.6% and 13.9% of sales for risks and opportunities, respectively, when suspect financial impacts are dropped), suggesting that some of the higher estimates are also those that are least supported or otherwise of suspect quality.

are each positively correlated with market values (*MVE*), while being negatively associated with the firm's information asymmetry as captured by the bid-ask spread (*BidAsk*). In the next sections we investigate the incremental role of a complete set of candidate determinants of climate-related disclosures as well as the impact of the disclosures on market-based metrics.

4.2. Disclosure Decisions

In this section, we empirically document the determinants of four corporate disclosure decisions, including whether firms respond to the CDP questionnaire, and whether they provide each of the following TCFD-related disclosures: physical and/or transition risks; estimates of the financial impacts of climate risks; and climate related opportunities.

Table 5 presents the results from probit models for each of these four decisions that control for financial variables and ownership characteristics (columns 1, 4, 7, and 10), that additionally control for country-level institutional and cultural principal-component factors (columns 2, 5, 8, and 11), and that additionally include industry and year fixed effects (i.e., our full model (1) in columns 3, 6, 9, and 12).

Many of the results in Table 5 are consistent with the prior literature or otherwise as expected, with size (*logSales*), foreign sales (*ForeignSale*), the industry level of disclosure (*IndPropDisc*), and institutional ownership (*InstOwn*) being reliably positively associated with all disclosure decisions, and blockholders (*Block*) being negatively associated with disclosure. Firms with higher growth prospects, as captured by the market-to-book ratio, are more likely to disclose, as evident from the negative coefficient on *BTM*. Surprisingly, firms with more liquidity (*Cash*) and better operating results (*ROA*) are less likely to disclose.[30] Loss-year firms (*Loss*) are weakly less likely to respond to the CDP survey whereas those with significant investments in internally generated intangibles (*IntangStock*) are reliably more likely to participate. On-balance-sheet intangibles (*IntangBS*) is not a consistently significant variable across specifications.

In terms of country-level characteristics, GDP per capita (*GDP*) is negatively associated with all disclosure decisions. The effectiveness of regulation (*F1RegEffect*) and cultural norms related to lower individualism and greater long-term orientation (*F2Cultural*) in the firm's

[30] In untabulated results, we run the disclosure decisions as linear probability models in OLS in order to check whether the variance inflation factors (VIFs) signal that there may be multicollinearity concerns affecting our coefficient estimates. The VIFs on the industry-year propensity to disclose variable (*IndPropDisc*) are unsurprisingly high when industry fixed effects are also included in the regression, but all other VIFs are well below threshold levels of concern (i.e., below 5, with most not higher than about 2.5).

country of headquarters respectively increase and decrease the firm's propensity to disclose for all but financial impact estimates. The factor capturing higher levels of personal accountability and freedom of the press (*F3Freedom*) is associated with a reliably higher likelihood of the firm being forthcoming across all disclosure decisions.

Columns 1 through 4 of Table 6 present the results of disclosure determinants models that additionally control for an array of variables that are included to capture aspects of the firm's governance and commitment to measuring, managing, and disclosing sustainability and environmental related issues. These include the ratio of independent directors (*IndepDir*), and indicators set to one if the firm has a sustainability committee (*SustCommittee*), an environmental management system (*EMS*), is a UN Global Compact signatory (*UNSign*), and produces a sustainability report (*SustReport*), respectively, and zero otherwise.

Although the ratio of independent directors has a surprisingly significant negative effect on all disclosure decisions, this becomes insignificant once the variables capturing other aspects of governance and commitment to sustainability are included in the models. Each of the *SustCommittee, EMS, UNSign* indicator variables is highly significantly positively associated with all disclosure decisions. Perhaps surprisingly, each of these variables is incrementally significant to all of the others, suggesting that each variable captures a different aspect of the firm's governance and prioritization of environmental or sustainability management and reporting. The indicator for sustainability report (*SustReport*) is also positively significant across decisions, but loses significance once the other arguably more refined proxies for environmental performance and/or disclosure discussed below are included in the model.

In columns 5 through 8 of Table 6 we include several additional variables capturing the firm's own environmental performance (i.e., as distinct from the impact of climate on the firm) and their propensities for environmental disclosures. Specifically, *logCO2e* is a measure of the firm's emissions. The firm's Refinitiv environmental pillar score (*EnvScore*) is supposed to capture the firm's environmental performance, however prior studies suggest that these scores may be largely driven by *disclosure* rather than impact (Drempetic et al., 2020; Raghunandan & Rajgopal, 2022). Finally, *CCExposure* is a measure of the firm's exposure to climate change that is derived from discussions on the firm's quarterly conference call and that therefore also captures aspects of the firm's environmental disclosure policy (Sautner et al., 2023). As shown, only *EnvScore* is reliably positively associated with the likelihood of disclosure for all four

decisions. The firm's emissions (*logCO2e*) is only significant in explaining the likelihood of disclosing the financial impacts and opportunities associated with climate risk, whereas *CCExposure* is only weakly positively associated with the disclosure of opportunities. After including the additional controls examined in Table 6, most of the previously reported findings from Table 5 remain intact except for the previously mentioned loss of independent directors.

In summary, larger, less liquid firms, those from industry-years with higher disclosure propensities, firms with higher capital expenditures, environmental performance scores, and institutional ownership, and companies that are headquartered in countries with more freedom of expression and freedom of the press are all more likely to voluntarily provide TCFD-compliant disclosures, while those with blockholders or that are from countries with higher GDP per capita are less likely to be forthcoming. Companies headquartered in countries with more effective regulation are also generally more likely to provide disclosures. Our results are important because they provide insights into which firms are likely to bear more adjustment costs, and whose stakeholders are likely to experience the greatest information gains when the TCFD-based ISSB disclosure standards, U.S. SEC regulations, and other country-specific mandates become mandatory. In the meantime, as voluntary climate- and nature-related disclosures become increasingly common and important, and their associations with market metrics and other real impacts correspondingly continue to be investigated, our disclosure decision models provide the most up to date and fully specified standard to be adopted for the first-stage selection models that future researchers will be required to estimate in order to address questions related to the second-stage real impacts of disclosure.

4.3 Capital Market Implications of Disclosure Decisions

In this section we examine whether firms' CDP survey responses and their provision of TCFD-compliant disclosures are relevant to equity market values and/or to bid-ask spreads.

4.3.1 Capital Market Implications of Responding to the CDP Survey

The balance sheet valuation model regression results presented in Table 7 show that firms that respond to the CDP survey do not have robustly higher market values, ceteris paribus. Specifically, while market values are higher by US$1,263 million in parsimonious balance sheet valuation models (i.e., column (1)), the coefficient on the CDP response indicator is not

significantly different from zero after controlling for *EnvScore*, *CCExposure*, and *logCO2e*, which collectively control for the firm's overall level of environmental disclosure, exposure, and performance. In other words, the Table 7 findings suggest that the positive market valuation effect of the CDP survey response indicator is not robust to the inclusion of environmental disclosure control variables.

The bid-ask spread regression results in columns (4)-(6) of Table 7 suggest that these disclosures nevertheless do materially reduce information asymmetry as captured by the equity bid-ask spread. Notably, the bid-ask spread-reducing impact of a CDP survey response is robust to the inclusion of the other environmental controls (i.e., *EnvScore, CCExposure,* and *logCO2e*). In our full Heckman models, CDP disclosures is, on average and ceteris paribus, associated with a 0.093% lower bid-ask spread, which translates into an economically significant reduction of approximately 25.3% over the mean bid-ask spread of 0.367%. Our findings are important because equity bid-ask spreads have a theoretical and empirical relation with the company's cost of equity capital. Thus, our findings are consistent with the notion that responding to the CDP survey can effectively reduce the firm's information risk, in turn reducing its cost of equity. The results pertaining to the other control variables in both the valuation and bid-ask spread models are generally in line with expectations.

Figure 1 Panel A and B provide coefficient plots summarizing the results of a host of additional valuation and bid-ask spread specifications, both when estimated with regular OLS and when estimated on entropy balanced samples using our full set of disclosure determinants variables. One important consideration in valuation models is the choice of scalar (e.g., Barth & Clinch, 2009). While unscaled valuation models have the most intuitive interpretation and are generally less biased than scaled valuation models, as a specification check we alternatively scale each of the *Asset, Liab, OpInc,* and *MVE* variables by common shares outstanding. In addition, we run specification checks using each of a "plain vanilla" model (i.e., no adjustments to income statement and balance sheet variables are made for investments in internally generated intangibles) and an Ohlson valuation model. We also alternatively define the disclosure dependent variable to be set to one only when the firm allows their CDP survey response to be public, and 0 otherwise, and also alternatively switch out our country factor loadings for country fixed effects. As is evident from the plots, the coefficient on the CDP disclosure indicator is highly significant when estimating parsimonious balance-sheet valuation models, but vanishes in models that include environmental

controls, country fixed effects, or that instead use share-deflated variables. The latter finding echoes those of Aswani et al. (2023) in the context of CO2e emissions. Moreover, the value relevance of CDP disclosure definitively disappears across all specifications when estimating the coefficient on an entropy balanced sample. In contrast, the CDP indicator is reliably significantly negatively associated with bid-ask spreads under each alternative specification. These findings provide heretofore undocumented evidence that responding to the CDP survey is reliable negatively associated with spreads in a global sample, but that the positive significance of CDP disclosure in valuation models does not persist when employing more demanding specifications or when more fully accounting for differences in observables between disclosing and non-disclosing firms.[31] Taken together, these findings suggest that there is, on average, negative (i.e., value-reducing) information in the CDP survey disclosures that offsets the value-enhancing effects of the increased transparency.

In additional analyses summarized in Figure 1, we estimate valuation and spread regressions separately for the two countries with the most observations in our sample (i.e., Japan and the United States) and for all other advanced economies in our sample pooled together. We find that both the valuation and spread coefficients are *insignificant* for both Japanese and US firms, while the spread results are economically stronger for firms headquartered in other advanced economies, consistent with environmental disclosure, regulations, and norms being stronger in European countries (e.g., Dyck et al., 2019).

4.3.2 Capital Market Implications of TCFD-Related Disclosures

The Heckman two-step market value regressions presented in Table 8 examine the information content of various TCFD-compliant climate risk and opportunity disclosures, after accounting for the self-selection effect of choosing to respond to the CDP survey request. Additional specifications are summarized in the coefficient plots in Figure 2A-D.[32] The findings in Table 8 column 1 and Figure 2A indicate that the incidence of a firm disclosing any climate

[31] In our full entropy balanced models, we also include the variables used for balancing to control for any differences between CDP respondents and non-respondents that have not been balanced away, except that we exclude *logSales* due to its high correlation with *Assets.* We continue to additionally report parsimonious specifications estimated on entropy-balanced samples that do not include the variables used for balancing, and the market value results also vanish in these parsimonious entropy-balanced specifications.

[32] The insignificance of the Mills ratio in some of our tabulated specifications should not be taken at face value as evidence of no selection effects (Lennox et al., 2012). Instead, our setting clearly faces selection effect concerns because of the voluntary nature of responding to the CDP's request for disclosure.

risk (i.e., *CR* = 1) is at best weakly associated with a reduction in market value. While the CR indicator is incrementally significant in Heckman models even after controlling for the firm's carbon emissions (*logCO2e*) and the inclusion of controls capturing the firm's environmental performance and disclosure score (*EnvScore*) and its potential vulnerability to climate change (*CCExposure*), the results are insignificant when estimated on entropy-balanced samples. Together, we find little evidence that *the act of disclosing* climate risk is robustly associated with firm value, especially since the insignificant entropy-balanced estimations face reduced model dependency concerns due to the preprocessing of data to achieve covariate balance (Hainmueller, 2012).

The results in columns 2 and 3 of Table 8, and in Panels B and C of Figure 2, show that any information content of climate risk disclosures fully derives from the (industry-year adjusted number of) *transition risk* disclosures (*NTransRisk_IA*) rather than from *physical risk* disclosures (*NPhysRisk_IA*). Importantly, both findings persist in all 14 alternative full-sample regression specifications. One possible explanation for physical risks offering no incremental information content is that these risks are potentially diversifiable, whereas transition risks are more systemic. Alternatively, physical risk information may be too divergent (Hain et al., 2021) or immaterial to be reflected in firm value. The results in column 4 offer further insights into transition risks, as the findings indicate that it is the numbers of regulatory and legal risks (*NLegalRegTrans_IA),* the number of reputational risks (*NRepTrans_IA)*, and the number of market risks (*NMarketTrans_IA)* that are credible and relevant to equity market participants, whereas technology risks (*NTechTrans_IA*) are not, on average, significantly associated with market values. Together, these findings suggest that it is the disclosure of climate *transition* risks that offers credible new information related to the potential *negative* impact of climate change on the firm that market participants incorporate into value. We thus provide important evidence that the disclosure of transition risks in accordance with the TCFD framework that underlies the new ISSB disclosure standard, the SEC's proposed regulations, and numerous state- or country-specific regulations provides relevant information for equity market participants, while physical risks do not.

An alternative explanation for our significant findings related to the market value implications of TCFD-related transition risk disclosures is that these variables are correlated with other environmental or climate risk information that is known to the market and that our model

does not control for. We note however that the regressions in which *NTransRisk_IA* and the transition risk subcomponents are significant do include controls for environmental disclosure as well as the firm's vulnerability to climate change, which should largely mitigate this concern. Furthermore, even if these TCFD-related transition risk variables are significant because of their correlation with other information, the finding that they are significant is important because whatever that other information is, its disclosure is not currently mandated, nor otherwise provided in a clear and consistent manner across firms and across time. As such, the standardization and eventual mandating of these TCFD-inspired disclosures (i.e., under the ISSB, the SEC, and other country-level regulations) should be valuable to market participants by helping to minimize the costs associated with searching for, and interpreting, what may otherwise be disparate and potentially inconsistently conveyed information.

The results in column 5 of Table 8 and Panel D of Figure 2 indicate that market values are not significantly associated with the industry-year adjusted number of climate related opportunities disclosed by the firm (*NOpportunity_IA*) across all 14 full-sample specifications. This finding is important to our understanding of the information content of TCFD-solicited "upside to climate change" disclosures, which are currently not captured by the SEC and other regulatory requirements to disclose "material risks" being faced by the firm. We believe the insignificant results are explained by the following factors. First, that it is generally accepted that optimistic firm-provided forward-looking information is inherently less credible than pessimistic disclosures as most incentives are to "talk up" rather than "talk down" the firm's prospects (Baginski et al., 2016) – i.e., because the information related to future opportunities is largely non-verifiable, it may be "cheap talk." This reasoning suggests that the market is likely to discount more heavily the climate opportunity disclosures relative to the more credible climate risk disclosures examined earlier. Second, it seems reasonable to assume that any future opportunity disclosures will be vaguer, more boilerplate, and less precise relative to the climate-related threat disclosures, on average, because disclosing precise and detailed information related to yet-to-be-realized climate-related opportunities would seem to entail a considerable level of proprietary costs. As such, firms are likely to offer more generic, boilerplate, and less precise disclosures that would be rationally subject to discounting by the market. This finding of market insignificance for climate opportunities has significant implications for the forthcoming IFRS S2 disclosures; firms will

need to navigate the S2 requirement to disclosure climate related opportunities in a credible manner while not giving away their competitive advantage related to these prospects.

In Table 9, we report the results of bid-ask spreads regressed on the same industry-year-adjusted TCFD climate risk and opportunity disclosure variables. The indicator capturing the incidence of climate risk disclosure (*CR*) is not associated with bid-ask spreads, nor are the number of transition risks, physical risks, or climate opportunities. The coefficient plots presented in Figure 3 confirm that the lack of association between bid-ask spreads and each of *CR*, *NTransRisk_IA*, *NPhysRisk_IA, and NOpportunity_IA* is a result that generally holds across model specifications and estimation methods. Although *CR* is negative and significant in entropy balanced specifications, and *NPhysRisk_IA* is positive and significant in some specifications, these results do not survive the inclusion of country fixed effects instead of country factors, and the combined evidence overwhelmingly suggests that there is no consistent and robust information asymmetry-reducing effect of climate-risk or opportunity disclosure, particularly when considering the *numbers* of disclosed risk.

Table 10 presents regressions of market values and bid-ask spreads on the aggregate disclosed financial impacts of climate risks (*FIEstimateRisk*) and opportunities (*FIEstimateOpp*), respectively. In expectation, these company insider estimates should be highly informative to market participants, particularly given that the cruder measures related to the mere disclosure of climate change risks (i.e., the CR indicator variable) and the adjusted count of transition risks were previously found to be associated with market values. Surprisingly, however, the financial impact estimates of risks are only weakly negative and opportunities are not significant in explaining market values. The bid-ask spread regressions in columns 3 and 4 suggest that neither the financial impact estimates of risks nor the estimates for opportunities are significantly related to this proxy for information asymmetry. The coefficient plots presented in Figure 4 for the alternative valuation models and Figure 5 for the alternative bid-ask spread regressions indicate that our general findings of weak or insignificance for the financial impacts of both climate risks and opportunities are robust to alternative model specifications and estimation methods, including those specifications that exclude suspect or potentially problematic financial impact estimates. Taken together, our findings suggest that the company-provided financial estimates are

too noisy, that their likelihood of realization is deemed to be too small, and/or that their proximity in time is expected to be too remote for the impact on value to be greater than zero, on average.[33]

4.3.3 Summary

In summary, our analyses of the corporate decision to respond to the CDP indicate that responding to the CDP is a positive signal associated with lower information asymmetry and higher market values in unscaled balance sheet valuation models, but that the market value results definitively disappear when more fully controlling for observable factors that are correlated with the decision to respond to the CDP. When it comes to the "gold standard" TCFD climate-related disclosures, our findings are decidedly mixed. An indicator for climate risk disclosures is weakly negatively associated with value, and we find that this negative effect is fully driven by transition risks and its subcomponents rather than by physical risks, suggesting that transition risk disclosures are credible, material, and relevant to market participants. However, we find no evidence that climate-related opportunities are associated with the market metrics examined in this study. Finally, financial impact estimates of the disclosed climate-related risks are largely and surprisingly irrelevant to both market values and bid-ask spreads, a finding that standard setters and regulators should perhaps be mindful of as they roll out mandatory TCFD-inspired disclosures going forward.

5. Conclusion

To the best of our knowledge, this study is the first to provide comprehensive evidence related to the determinants and market implications of TCFD-compliant disclosures for a large global sample of firms from advanced economies. Our findings are important because the TCFD framework underlies the new IFRS S2 climate disclosure standard, the State of California and the SEC's proposed climate reporting regulations, and numerous other pending country-specific climate disclosure regulations. By documenting the factors associated with the voluntary disclosure of TCFD-related information, our study provides insights into which firms are likely to experience greater transition costs and whose stakeholders are likely to experience greater information gains if/when the various new TCFD-based standards/regulations lead to mandated

[33] In untabulated regressions, we examine whether the financial impacts of physical risks and transition risks are separately associated with market values. None of the financial impact estimates are significant in any regression specifications.

disclosures. Although climate-related opportunity disclosures do not appear to be sufficiently credible to be relevant to market values or bid-ask spreads, climate change risk disclosures, particularly those pertaining to transition risks, are associated with market values. However, the financial impact estimates related to these climate risks do not appear to be sufficiently credible, likely, or proximate in time to be priced by capital markets.

The results of our study should be of relevance to regulators, standard setters, disclosing firms and their consultants and auditors, as well as to market participants in anticipation of global rollouts of TCFD-based disclosures, not least IFRS S2. Our findings from a large sample of voluntary climate disclosures suggest that many aspects of TCFD disclosures are not incorporated into market prices, perhaps indicating that market participants are inattentive to these climate risks and opportunities, that they are unable to fully comprehend the disclosures, and/or that they do not consider them to be of sufficient credibility, proximity in time, or financial materiality to be reflected in prices.

Appendix A: Financial Impact Data Integrity Checks

We develop an algorithm to check the financial impact data for "suspect" and "problematic" observations. Suspect observations are those financial impact estimates that lack explanations or provide explanations in a language other than English (e.g., the reporters' local language). Problematic observations are those financial impact estimates that are likely to be erroneously reported. We undertook an extensive manual review of the full financial impact data for the years 2018-2022 before developing our algorithm that tags suspect observations and distinguishes between six categories of potentially problematic observations. We rely on both the reported financial impact estimates and the associated explanations to tag observations that are suspect or potentially problematic. Specifically:

1) We tag observations as suspect if financial impact estimate explanations are fully missing, or if firms report "na" as the financial impact explanation. We further tag observations as suspect if the indicated reporting language is not English *and* the financial impact explanation does not contain any of the commonly used English words "the", "and", or "of".

2) We tag observations as problematic if any of the following conditions hold:

    a. Duplicates: We tag a financial impact estimate as a problematic duplicate if there are multiple of the same financial impact estimates for distinct reported risks or opportunities for a given firm-year. For instance, a firm reports a financial impact estimate of $1 million for each of its disclosed risks in a given firm-year.

    b. Double counting: We classify observations as "double counting" when firms report both a single financial impact figure and a range that includes both minimum and maximum estimates, while only one of the two is requested.

    c. Currency: Some firms report financial impact estimates in a different currency than their indicated reporting currency. For example, the indicated reporting currency is a firm's local currency but the financial impact estimates are reported in USD. We tag financial impact estimates as potentially having currency issues by contrasting the indicated reporting currency with mentions of currencies in the

financial impact explanations. Specifically, we use string matching and regular expressions to search for mentions of currencies in the financial impact estimates that are different from the currency the firm is supposed to report in. If the indicated reporting currency is not mentioned but other currencies are mentioned, the observation is problematic. If no currency is mentioned in the financial impact explanation, we assume the firm reports correctly.

d. Placeholder: Firms tend to insert placeholder figures when they are unable or unwilling to report financial impact estimates. We first classify all financial impact estimates <= 1 as placeholders. We then search financial impact explanations for variants of "not/difficult" in conjunction with "estimate/predict/quantify" and for variants of "confidential" and "illustrative" to tag all observations where firms insert placeholders because of confidentiality issues or because they consider it difficult or impossible to quantify the financial impacts of the disclosed risks.

e. Unit: Some firms report financial impact estimates in, for instance, percentages, barrels, or MWh, while monetary units are requested. We tag all financial impact estimates that are <= 100 and use "%" or variants of "percent" in the explanations. We tag all financial impact estimates that use variants of "mwh" or "barrel", and additionally check for discrepancies between mentions of "millions" and "billions" and reported financial impact figures to capture instances where firms report in e.g., millions or billions while firms are asked to report the figures in full (i.e., unabbreviated).

f. Entity: Some firms report financial impact estimates that are not properly aggregated at the entity level. For instance, some firms give an example of the financial impact of a hurricane or flooding at one facility instead of the expected financial impact of physical risks at the firm-level. We check for occurrences of "one", "per", "a", "an", and "each" in combination with a dictionary of nouns

including “building”, “facility”, “property”, “event”, “vessel”.[34] We additionally tag financial impact estimates as having entity problems if the firm mentions “not aggregated” in the financial impact estimate.

While we cast a wide and comprehensive net to capture financial impact estimates that are inadequately reported, we cannot preclude the possibility that our approach results in false negatives (i.e., accurately reported financial impact estimates tagged as potentially problematic). We therefore take an iterative approach by increasingly dropping more categories of potentially problematic observations in our analyses investigating the value relevance of the financial impact estimates.

Figure A1 summarizes the frequency of each of these problems for the subset of CDP survey respondents with non-missing financial impacts of risk estimates that end up in our sample (i.e., a subset of the full CDP survey data, with typically multiple risks and corresponding financial impacts reported per firm-year). Out of the 16,188 observations in these data, we identify a total of 6,184 (38.2%) to be potentially problematic and a further 2,325 (14.3%) to be suspect.

Figure A2 similarly summarizes the frequency of problems for financial impact estimates of opportunities. Out of the 14,236 non-missing financial impacts of opportunities for our sample firms, we identify a total of 4,913 (34.5%) to be potentially problematic and a further 1,933 (13.6%) as suspect.

[34] The full list of nouns considered is: “day”, “week”, “month”, “project”, “claim”, “building”, “site”, “facility”, “plant”, “factory”, “customer”, “client”, “property”, “storm”, “hurricane”, “heatwave”, “wildfire”, “flood”, “hotel”, “house” , “event”, “vessel”, and “center”.

Figure A1: Frequency of Identified Problems Financial Impact Estimates Risks

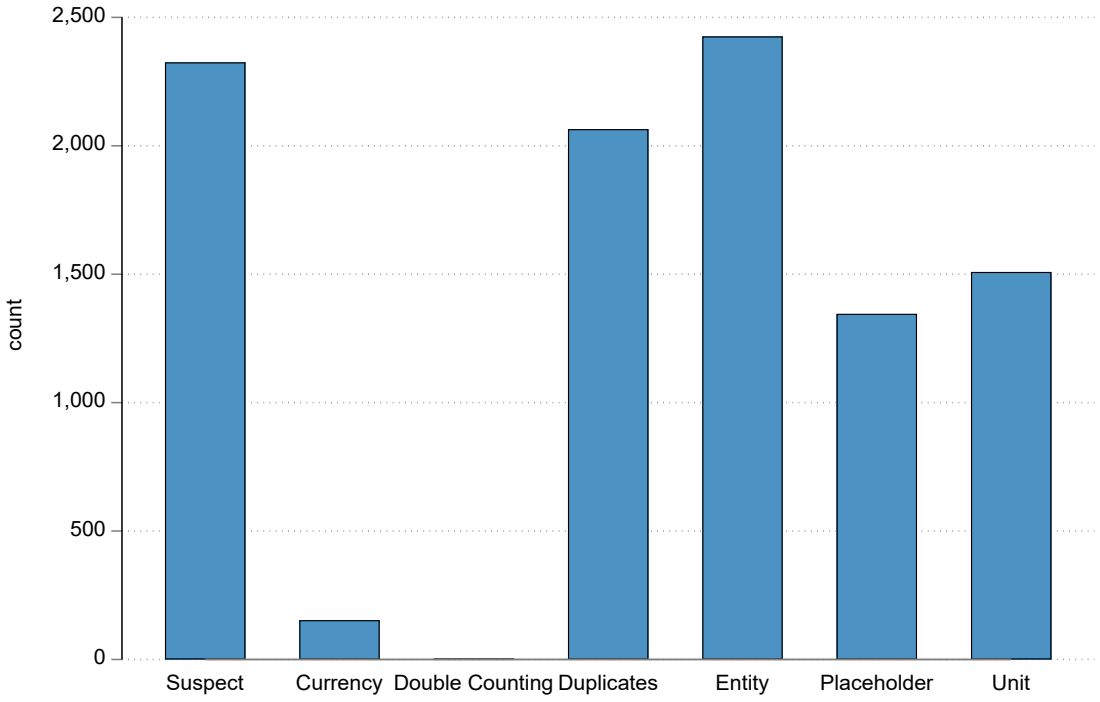
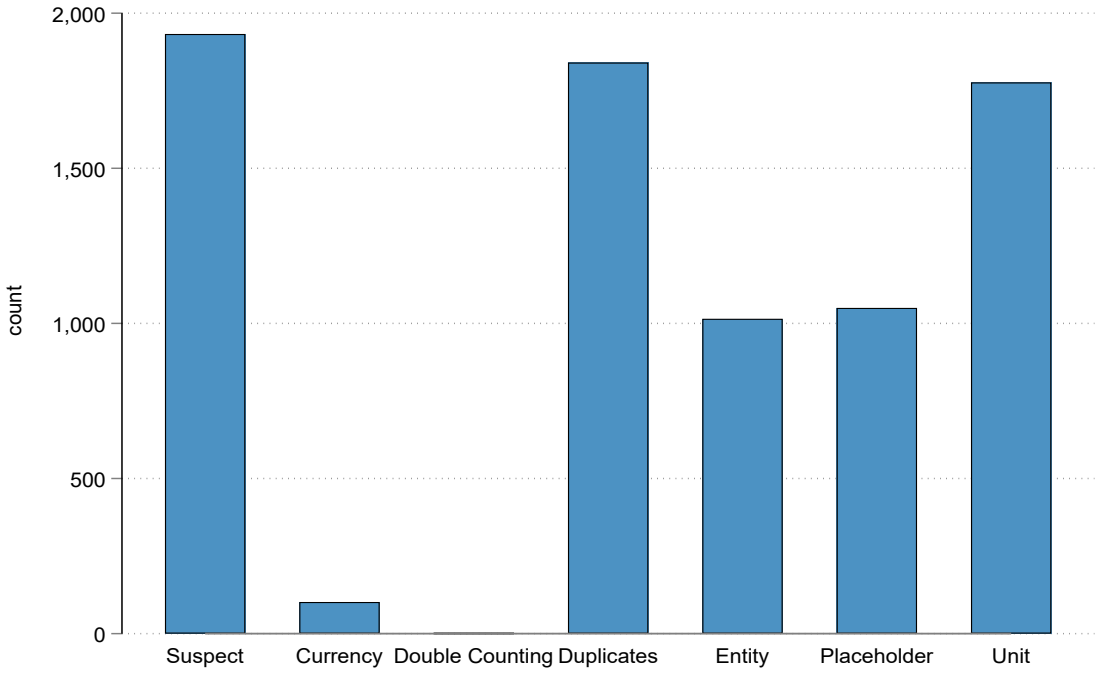


Figure A2: Frequency of Identified Problems Financial Impact Estimates Opportunities



Appendix B: Factor Analysis Country-level Institutional and Cultural Features

We undertake a principal-component factor analysis to extract uncorrelated factors that capture the country-level institutional and cultural features of a firm's country of headquarters. Country-level institutional and cultural features may be important determinants of firms' CDP and TCFD disclosure decisions, but most of the features are highly correlated. We thus include the uncorrelated factors instead of the underlying country-level features in our regression models. To construct the factors, we obtain data on 13 country features from the World Bank, Hofstede's website, Djankov et al. (2008), Reporters Without Borders, and the World Economic Forum Global Competitiveness Index. Specifically:

- We consider each of the six World Bank Worldwide Governance Indicators, capturing control of corruption (*ControlCorrupt),* the effectiveness of the government (*GovEffect),* political stability and absence of violence and terrorism (*PolStabil),* regulatory quality (*RegQual),* rule of law (*RuleofLaw),* and voice and accountability (*VoiceAccount).*
- We consider four Hofstede cultural dimensions, capturing power distance (*PowerDistance),* collectivism versus individualism (*Individualism),* uncertainty avoidance (*UncertaintyAvoid),* and long-term versus short-term orientations (*LongTermOrient).*
- We obtain the average of the ex-ante and ex-post control for self-dealing from Djankov et al. (2008) (*Anti-Self).*
- We obtain the Press Freedom Score from Reporters Without Borders (*PressFreedom)*.
- We obtain the efficiency of the legal system in settling disputes from the World Economic Forum Global Competitiveness Index Historical Dataset (*LegalFrameworkDisputes).*

We standardize all variables before estimating the factors. We obtain all country-level data from public sources and all data are available upon request.

Results

Table B.1 Panel A presents the eigenvalues and proportions of explained variance of the estimated principal-component factors. We identify three principal-component factors with an eigenvalue larger than one. These principal-component factors together explain over 90% of the

variation in the underlying country-level institutional and cultural features variables. Table B.1 Panel B presents the rotated factor loadings:

- Factor 1 is highly correlated with the Worldwide Governance Indicators capturing the effectiveness and quality of governments and regulations: *ControlCorrupt, GovEffect, RuleofLaw,* and *RegQual.* We name this first factor *F1RegEffect*.
- Factor 2 is highly correlated with the Hofstede dimensions *UncertaintyAvoid, Individualism,* and *LongTermOrient.* We name this second factor *F2Cultural*.
- Factor 3 is highly correlated with *PressFreedom* and *VoiceAccount.* We name this third factor *F3Freedom.*

Summary statistics for the three factors are provided in Table B.2.

Table B.1: Factor analysis

Panel A: Eigenvalues factors

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.289	2.457	0.482	0.482
Factor2	2.832	0.856	0.258	0.740
Factor3	1.976	1.461	0.180	0.920
Factor4	0.514	0.182	0.047	0.967
Factor5	0.332	0.141	0.030	0.997
Factor6	0.191	0.093	0.017	1.015
Factor7	0.098	0.074	0.009	1.024
Factor8	0.024	0.026	0.002	1.026
Factor9	-0.002	0.036	-0.000	1.026
Factor10	-0.039	0.023	-0.004	1.022
Factor11	-0.062	0.013	-0.006	1.016
Factor12	-0.075	0.032	-0.007	1.010
Factor13	-0.107	.	-0.010	1.000

Panel B: Rotated factor loadings

Variable	Factor1	Factor2	Factor3	Uniqueness
PressFreedom	0.080	-0.185	0.865	0.153
ControlCorupt	0.846	0.004	0.338	0.082
GovEffect	0.910	0.119	0.013	0.105
PolStabil	0.430	0.518	0.241	0.227
RuleofLaw	0.952	-0.090	0.188	0.039
RegQual	0.816	-0.129	0.157	0.125
VoiceAccount	0.201	-0.125	0.890	0.066
PowerDistance	-0.273	0.493	-0.532	0.257
Individualism	0.101	-0.885	0.274	0.080
UncertaintyAvoid	-0.315	0.514	-0.102	0.108
LongTermOrient	-0.032	0.858	-0.113	0.121
AntiSelf	0.115	-0.349	-0.366	0.297
LegalFrameworkDisputes	0.812	-0.317	-0.148	0.086

Table B.2: Descriptive Statistics Factors

	N	Mean	SD	Min	p25	Median	p75	Max
F1RegEffect	17272	0	0.985	-4.944	-.331	.244	.518	2.611
F2Cultural	17272	0	0.951	-1.415	-.587	.041	.72	1.889
F3Freedom	17272	0	0.962	-4.481	-.636	-.075	.699	2.023

Appendix C: Variable Definitions[35]

Variable Name	Definition	Data Source
Asset	Total assets in millions of USD. Adjusted for notionally capitalized and unamortized intangibles.	Worldscope
BidAsk	The median bid-ask spread over the CDP disclosure year. Measured as (ask-bid)/((ask+bid)/2).	Datastream
Block	Indicator variable taking the value of one if there is an investor owning more than 5% of shares outstanding in the most recent quarter with data available before the fiscal year-end, and zero otherwise. Set to zero if missing.	Refinitiv EIKON
BTM	Common Shareholders Equity / Market Capitalization of Common Shareholders' Equity adjusted for *IntangStock*. Measured at fiscal year-end.	Worldscope and Datastream
CapEx	Capital Expenditures / AT. Set to zero if missing.	Worldscope
Cash	Cash and Short-term Investments / AT.	Worldscope
CCExposure	Firm-specific equal-weighted climate change exposure based on earnings calls (cc_expo_ew). In order to retain our full sample size, we estimate a fitted model for *CCExposure* as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of *CCExposure* with the fitted values.	Sautner et al. (2023).
CDP	Indicator variable taking the value of one if a firm responded to the CDP survey disclosure request, and zero otherwise.	CDP Climate Change Survey Response Database
CDP_private	Indicator variable taking the value of one if a firm responded to the CDP survey but did not give permission to make their response publicly available on the CDP website.	CDP Climate Change Survey Response Database
CDP_public	Indicator variable taking the value of one if a firm responded to the CDP and gave permission make their response publicly available on the CDP website, and zero otherwise.	CDP Climate Change Survey Response Database
CR	Indicator variable taking the value of one if a firm provides climate risk information in its response to the CDP survey in a disclosure year, and zero otherwise. We require firms to both disclose the types of risks and give a description of the risks.	CDP Climate Change Survey
EMS	Indicator variable taking the value of one if a firm has an environmental management system and/or ISO 14000 certification, and zero otherwise.	Refinitiv EIKON
EnvScore	Refinitiv EIKON Environmental Pillar Score. In order to retain our full sample size, we estimate a fitted model for *EnvScore* as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of *EnvScore* with the fitted values.	Refinitiv EIKON
F1RegEffect	The first principal component country factor. This factor is highly correlated with Worldwide Governance Indicators capturing the effectiveness of governments and regulation.	See Appendix B
F2Cultural	The second principal component country factor. This factor is highly correlated with several Hofstede cultural dimensions.	See Appendix B
F3Freedom	The third principal component country factor. This factor is highly correlated with metrics of individual and press freedom.	See Appendix B
FI	Indicator variable taking the value of one if the firm provides a point estimate or estimated range of the financial impact of one or more of the disclosed climate risks in a disclosure year, and zero otherwise.	CDP Climate Change Survey

[35] All total asset scalars include notionally capitalized and unamortized intangibles investments.

FIEstimateOpp	The aggregated disclosed financial impact amounts of climate opportunities in a disclosure year in USD millions. Taken as the midpoint of the range if a range instead of a point estimate is provided.	CDP Climate Change Survey
FIEstimateOpp_S	The aggregated disclosed financial impact amounts of climate opportunities in a disclosure year in USD scaled by sales. Taken as the midpoint of the range if a range instead of a point estimate is provided.	CDP Climate Change Survey
FIEstimateRisk	The aggregated disclosed financial impact amounts of climate risks in a disclosure year in USD millions. Taken as the midpoint of the range if a range instead of a point estimate is provided.	CDP Climate Change Survey
FIEstimateRisk_S	The aggregated disclosed financial impact amounts of climate risks in a disclosure year in USD scaled by sales. Taken as the midpoint of the range if a range instead of a point estimate is provided.	CDP Climate Change Survey
ForeignSale	International sales as a percentage of total sales. Set to zero if missing.	Worldscope
GDP	GDP per capita in USD purchasing power parity terms.	World Bank
IndepDir	The percentage of independent board directors.	Refinitiv EIKON
IndPropDisc	The propensity of reporting to the CDP in a firm's FF48 industry group in our sample. Measured for each disclosure year.	CDP Climate Change Survey Response Database
InstOwn	Percentage of shares owned by institutional investors. We consider the following Refinitiv investor categories as institutional: "Bank and Trust", "Brokerage Firms", "Closed-End Fund", "Corporation", "Endowment Fund", "ETF", "Foundation", "Government Agency", "Hedge Fund", "Hedge Fund Portfolio", "Holding Company", "Independent Research Firm", "Institution", "Insurance Company", "Investment Advisor", "Mutual Fund", "Pension Fund", "Private Equity", "Research Firm", "Sovereign Wealth Fund", and "Venture Capital". Set to zero if missing, truncated at 100%, and measured in the month of the firm's fiscal year end.	Refinitiv EIKON
IntangBS	On-balance sheet goodwill and other intangibles, net / AT.	Worldscope
IntangStock	Stock-transformed R&D+⅓*SG&A scaled by total assets using 5-year amortization. E.g., *IntangStock* for fiscal 2019 = FY2019 (R&D+⅓SGA)*100% + FY2018 (R&D+⅓SGA)*80% + FY2017 (R&D+⅓SGA)*60% + FY2016 (R&D+⅓SGA)*40% + FY2015 (R&D+⅓SGA)*20% / AT. R&D and SG&A are set to zero if missing. In case of insufficient data availability, we assume the first available R&D and SG&A expense to be indicative of prior years. For IFRS firms, capitalized development expenditures added to *IntangStock* and R&D adjusted for amortization of capitalized development expenses. R&D subtracted from SG&A unless R&D > SG&A & R&D < COGS (Peters & Taylor, 2017).	Worldscope
Liab	Total liabilities in millions of USD.	Worldscope
logCO2e	The log-transformed sum of Scope 1 and Scope 2 emissions scaled by sales in USD millions. In order to retain our full sample size, we estimate a fitted model for *logCO2e* as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of *logCO2e* with the fitted values.	Refinitiv EIKON
logRetVar	The standard deviation of monthly returns over the CDP disclosure year. Lagged by one year. Log-transformed.	Datastream
logSales	Log-transformed sales or revenues in millions of USD.	Worldscope
logShareTurn	The aggregate USD volume of shares traded over the CDP disclosure year divided by the USD market cap. Lagged by one year. Log-transformed.	Datastream
MVE	Market value of equity in millions of USD. Measured at CDP disclosure year end.	Datastream
NClimateRisk	The total number of physical and transition risks disclosed by a firm in a disclosure year.	CDP Climate Change Survey

NLegalRegTrans_IA	The industry-year adjusted number of transition risks disclosed by a firm in a disclosure year relating to legal and regulatory risks.	CDP Climate Change Survey
NMarketTrans_IA	The industry-year adjusted number of transition risks disclosed by a firm in a disclosure year relating to market and customers.	CDP Climate Change Survey
NPhysRisk_IA	The industry-year adjusted number of disclosed physical risks by a firm in a disclosure year. RiskType either "Physical risk", "Chronic physical", or "Acute physical".	CDP Climate Change Survey
NRepTrans_IA	The industry-year adjusted number of transition risks disclosed by a firm in a disclosure year relating to reputational risks.	CDP Climate Change Survey
NTechTrans_IA	The industry-year adjusted number of transition risks disclosed by a firm in a disclosure year relating to technology.	CDP Climate Change Survey
NTransRisk_IA	The industry-year adjusted number of disclosed transition risks by a firm in a disclosure year. RiskType either "Current regulation", "Emerging regulation", "Legal", "Market", "Reputation", "Technology".	CDP Climate Change Survey
NOpportunity_IA	The industry-year adjusted number of climate-related opportunities disclosed by a firm in a disclosure year.	CDP Climate Change Survey
Opp	Indicator variable taking the value of one if the firm discloses any climate-related opportunities in a disclosure year. We require firms to both disclose the types of opportunities and give a description of the opportunities.	CDP Climate Change Survey
OpInc	Operating income in millions of USD. Adjusted for intangibles capitalization and amortization. See *ROA*.	Worldscope
PPE	Property, plant, & equipment, net / AT. Set to zero if missing.	Worldscope
ROA	Return on assets, adjusted for the amortization of R&D and ⅓*SG&A. (Operating Income After Depreciation and Amortization + R&D + ⅓SG&A – RD⅓SGA_amort) / AT. RD⅓SGA_amort calculated assuming 20% annual amortization. For IFRS firms, R&D adjusted for amortization of capitalized development expenses. R&D subtracted from SG&A unless R&D > SG&A & R&D < COGS (Peters & Taylor, 2017).	Worldscope
SustCommittee	Indicator variable taking the value of one if a firm has a board-level CSR committee, and zero otherwise.	Refinitiv EIKON
SustReport	Indicator variable taking the value of one if a firm has a stand-alone or integrated sustainability report, and zero otherwise.	Refinitiv EIKON
UNSign	Indicator variable taking the value of one if a firm is a signatory of the UN Global Compact, and zero otherwise.	Refinitiv EIKON

References

Amel-Zadeh, A., Lustermans, R., & Pieterse-Bloem, M. (2022). *Do Sustainability Ratings Matter? Evidence from Private Wealth Investment Flows.* SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3576687

Arnold, M. (2020, October 14). ECB to consider using climate risk to steer bond purchases, says Lagarde. *Financial Times. https://www.ft.com/content/f5f34021-795f-47a2-aade-72eb5f455e09*

Aswani, J., Raghunandan, A., & Rajgopal, S. (2023). Are Carbon Emissions Associated with Stock Returns? *Review of Finance,* 1-32. https://doi.org/10.1093/rof/rfad013

Baginski, S., Demers, E., Wang, C., & Yu, J. (2016). Contemporaneous verification of language: evidence from management earnings forecasts. *Review of Accounting Studies, 21,* 165-197. https://doi.org/10.1007/s11142-015-9347-6

Banerjee, S., Chen, A., Li, M., Mehrotra, V., & Vijayaraghavan, R. (2023). *Voluntary Climate Disclosures: A Tale of Two Venues.* SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4575733

Barker, R., & Eccles, R. G. (2018, October 12). *Should FASB and IASB be responsible for setting standards for nonfinancial information?* University of Oxford, Saïd Business School. https://www.sbs.ox.ac.uk/sites/default/files/2018-10/Green%20Paper_0.pdf

Barker, R., & Eccles, R. G. (2020, December 31). *Comment Letter in response to the Consultation Paper on Sustainability Reporting*. IFRS Foundation. https://eifrs.ifrs.org/eifrs/comment_letters//570/570_27802_RichardBarkerRichardBarkerBobEccles_0_IFRSQuestionsforconsultationBarkerandEccles31Dec2020.pdf

Barth, M. E., & Clinch, G. (2009). Scale Effects in Capital Markets-Based Accounting Research. *Journal of Business Finance & Accounting, 36*(3-4), 253-288. 10.1007/s11142-021-09609-5

Barth, M. E., & McNichols, M. F. (1994). Estimation and Market Valuation of Environmental Liabilities Relating to Superfund Sites. *Journal of Accounting Research*, *32*, 177–209. https://doi.org/10.2307/2491446

Berkman, H., Jona, J., & Soderstrom, N. (2022). *Firm-Specific Climate Risk and Market Valuation.* SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2775552

Beyer, A., Cohen, D. A., Lys, T. Z., & Walther, B. R. (2010). The financial reporting environment: Review of the recent literature. *Journal of Accounting and Economics*, *50*(2), 296–343. https://doi.org/10.1016/j.jacceco.2010.10.003

BNY Mellon (2019). *Future 2024: Future-Proofing Your Asset Allocation in the Age of Mega Trends*. https://www.bnymellonim.com/outlook/reports/

Bolton, P., & Kacperczyk, M. (2021). *Signaling through Carbon Disclosure*. SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3755613

Bolton, P., & Kacperczyk, M. (2022). Global Pricing of Carbon-Transition Risk. *Journal of Finance.* Forthcoming.

CFTC. (2020). *Managing Climate Risk in the U.S. Financial System: Report of the Climate-Related Market Risk Subcommittee, Market Risk Advisory Committee of U.S. Commodity Futures Trading Commission*. https://www.cftc.gov/PressRoom/PressReleases/8234-20

Chapple, L., Clarkson, P. M., & Gold, D. L. (2013). The Cost of Carbon: Capital Market Effects of the Proposed Emission Trading Scheme (ETS). *Abacus*, *49*(1), 1–33. https://doi.org/10.1111/abac.12006

Cho, C. H, & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: a research note. *Accounting, Organizations and Society,* 32, 639-647. https://doi.org/10.1016/j.aos.2006.09.009

Choi, B., & Luo, L. (2021). Does the market value greenhouse gas emissions? Evidence from multi-country firm data. *The British Accounting Review*, *53*(1), 1–24. https://doi.org/10.1016/j.bar.2020.100909

Christensen, H. B., Hail, L., & Leuz, C. (2021). Mandatory CSR and sustainability reporting: economic analysis and literature review. *Review of Accounting Studies, 26*, 1176-1248. 10.1007/s11142-021-09609-5

Christophers, B. (2019). Environmental Beta or How Institutional Investors Think about Climate Change and Fossil Fuel Risk. *Annals of the American Association of Geographers*, *109*(3), 754–774. https://doi.org/10.1080/24694452.2018.1489213

Clarkson, P. M., Fang, X., Li, Y., & Richardson, G. (2013). The relevance of environmental disclosures: Are such disclosures incrementally informative? *Journal of Accounting and Public Policy*, *32*(5), 410–431. https://doi.org/10.1016/j.jaccpubpol.2013.06.008

Clarkson, P. M., Li, Y., Pinnuck, M., & Richardson, G. D. (2015). The Valuation Relevance of Greenhouse Gas Emissions under the European Union Carbon Emissions Trading Scheme. *European Accounting Review*, *24*(3), 551–580. https://doi.org/10.1080/09638180.2014.927782

Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society*, *33*(4-5), 303–327. https://doi.org/10.1016/j.aos.2007.05.003

Cohen, S., Kadach, I., & Ormazabal, G. (2023). Institutional investors, climate disclosure, and carbon emissions. *Journal of Accounting and Economics.* https://doi.org/10.1016/j.jacceco.2023.101640

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2010). Signaling Theory: A Review and Assessment. *Journal of Management*, *37*(1), 39–67. https://doi.org/10.1177/014920631038841

Cormier, D., & Magnan, M. (1997). Investors' assessment of implicit environmental liabilities: An empirical investigation. *Journal of Accounting and Public Policy*, *16*(2), 215–241. https://doi.org/10.1016/S0278-4254(97)00002-1

Cormier, D., & Magnan, M. (1999). Corporate Environmental Disclosure Strategies: Determinants, Costs and Benefits. *Journal of Accounting, Auditing & Finance*, *14*(4), 429–451. https://doi.org/10.1177/0148558X9901400403

Daske, H., Hail, L., Leuz, C., & Verdi, R. (2013). Adopting a Label: Heterogeneity in the Economic Consequences Around IAS/IFRS Adoptions. *Journal of Accounting Research, 51*(3), 495-547. 10.1111/1475-679X.12005

Demers, E., Hendrikse, J., Joos, P., & Lev, B. (2021). ESG did not immunize stocks during the COVID-19 crisis, but investments in intangible assets did. *Journal of Business Finance & Accounting*, *48*(3-4), 433–462. https://doi.org/10.1111/jbfa.12523

Depoers, F., Jeanjean, T., & Jérôme, T. (2016). Voluntary Disclosure of Greenhouse Gas Emissions: Contrasting the Carbon Disclosure Project and Corporate Reports. *Journal of Business Ethics, 134,* 445-461. https://doi.org/10.1007/s10551-014-2432-0

Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary Nonfinancial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting. *The Accounting Review*, *86*(1), 59–100. https://doi.org/10.2308/accr.00000005

Ding, D., Liu, B., & Chang, M. (2023). Carbon Emissions and TCFD Aligned Climate-Related Information Disclosures. *Journal of Business Ethics, 182*, 967-1001. https://doi.org/10.1007/s10551-022-05292-x

Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2008). The law and economics of self-dealing. *Journal of Financial Economics, 88*(3), 430-465. https://doi.org/10.1016/j.jfineco.2007.02.007

Drempetic, S., Klein, C., & Zwergel, B. (2020). The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics, 167*, 333-360. https://doi.org/10.1007/s10551-019-04164-1

Dyck, A., Lins, K. V., Roth, L., & Wagner, H. F. (2019). Do institutional investors drive corporate social responsibility? International evidence. *Journal of Financial Economics, 131*, 693-714. https://doi.org/10.1016/j.jfineco.2018.08.013

Edmans, A., Pu, D., Zhang, C., & Li, L. (2023). Employee Satisfaction, Labor Market Flexibility, and Stock Returns around the World. *Management Science.* Forthcoming.

Engler, H. (2023). Companies need to integrate climate reporting across functions to comply with California's new law - Thomson Reuters Institute. Accessed January 21st, 2024.

European Commission. (2023). *Corporate Sustainability Reporting. https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en*

Fama, E. F., & French, K. R. (1995). Size and Book-to-Market Factors in Earnings and Returns. *The Journal of Finance, 50*(1), 131-155. https://doi.org/10.1111/j.1540-6261.1995.tb05169.x

Financial Conduct Authority. (2020, December 21). *FCA introduces rule to enhance climate-related disclosures* [Press release]. https://www.fca.org.uk/news/news-stories/fca-introduces-rule-enhance-climate-related-disclosures

Financial Stability Board. (2021). *About the FSB*. https://www.fsb.org/about/#:~:text=The%20Financial%20Stability%20Board%20%28FSB%29%20is%20an%20international,the%20global%20financial%20system.%20Mandate%20of%20the%20FSB

Fink, L. (2020). *A Fundamental Reshaping of Finance*. Blackrock. https://www.blackrock.com/corporate/investor-relations/2020-larry-fink-ceo-letter

Fink, L. (2021). *Larry Fink's 2021 letter to CEOs*. Blackrock. https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter

Fink, L. (2022). *The Power of Capitalism.* Blackrock. https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter

Flammer, C., Toffel, M. W., & Viswanathan, K. (2021). Shareholder activism and firms' voluntary disclosure of climate change risks. *Strategic Management Journal*, *42*(10), 1850-1879. https://doi.org/10.1002/smj.3313

Global Sustainable Investment Alliance (2019). *Sustainable Investor Poll on TCFD Implementation*. http://www.gsi-alliance.org/members-resources/sustainable-investor-poll-on-tcfd-implementation

Gray, R., Kouhy, R., & Lavers, S. (1995). Corporate social and environmental reporting. *Accounting, Auditing & Accountability Journal*, *8*(2), 47–77

Griffin, P. A., Lont, D. H., & Sun, E. Y. (2017). The Relevance to Investors of Greenhouse Gas Emission Disclosures. *Contemporary Accounting Research*, *34*(2), 1265–1297. https://doi.org/10.1111/1911-3846.12298

Hahn, R., Reimsbach, D., & Schiemann, F. (2015). Organizations, Climate Change, and Transparency. *Organization & Environment*, *28*(1), 80–102. https://doi.org/10.1177/1086026615575542

Hainmueller, J. (2012). Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. *Political Analysis, 20*(1), 25-46. https://doi.org/10.1093/pan/mpr025

Hart, O., & Zingales, L. (2017). Companies Should Maximize Shareholder Welfare Not Market Value. *Journal of Law, Finance, and Accounting*, *2*(2), 247–275. https://doi.org/10.1561/108.00000022

Hain, L. I., Kölbel, J. F., & Leippold, M. (2021). *Let's Get Physical: Comparing Metrics of Physical Climate Risk.* SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3829831

Hartzmark, S. M., & Sussman, A. B. (2019). Do Investors Value Sustainability? A Natural Experiment Examining Ranking and Fund Flows. *The Journal of Finance*, *124*(6), 2789-2837. 10.1111/jofi.12841

Healy, P. M., & Palepu, K. G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting and Economics*, *31*(1), 405–440. https://doi.org/10.1016/S0165-4101(01)00018-0

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica, 47*(1), 153-161. https://doi.org/10.2307/1912352

Herbohn, K., Gao, R., & Clarkson, P. (2019). Evidence on Whether Banks Consider Carbon Risk in Their Lending Decisions. *Journal of Business Ethics*, *158*(1), 155–175. https://doi.org/10.1007/s10551-017-3711-3

Herren Lee, A. (2020). *"Modernizing" Regulation S-K: Ignoring the Elephant in the Room*. https://www.sec.gov/news/public-statement/lee-mda-2020-01-30#_ftn13

HM Treasury (2020, November 9). *UK joint regulator and government TCFD Taskforce: Interim Report and Roadmap* [Press release]. https://www.gov.uk/government/publications/uk-joint-regulator-and-government-tcfd-taskforce-interim-report-and-roadmap

Hook, L., & Vincent, M. (2021, November 12). Green business reporting rules at risk of pale response. *Financial Times*. https://www.ft.com/content/ad01f2c9-9eb0-4db6-9898-220c688d16c2

Hsu, P., Li, K., & Tsou, C. (2023). The Pollution Premium. *Journal of Finance, 78*(3), 1343-1392. https://doi.org/10.1111/jofi.13217

Hughes, K. E. (2000). The Value Relevance of Nonfinancial Measures of Air Pollution in the Electric Utility Industry. *The Accounting Review*, *75*(2), 209–228. https://doi.org/10.2308/accr.2000.75.2.209

IFRS Foundation. (2021, November 3). *IFRS Foundation announces International Sustainability Standards Board, consolidation with CDSB and VRF, and publication of prototype disclosure requirements* [Press release]. https://www.ifrs.org/news-and-events/news/2021/11/ifrs-foundation-announces-issb-consolidation-with-cdsb-vrf-publication-of-prototypes/

Ilhan, E., Krueger, P., Sautner, Z., & Starks, L. T. (2023). Climate Risk Disclosure and Institutional Investors. *The Review of Financial Studies.* https://doi.org/10.1093/rfs/hhad002

International Monetary Fund (2020). Climate Change: Physical Risk and Equity Prices. In International Monetary Fund (Ed.), *Global Financial Stability Report: Markets in the Time of COVID-19.* (pp. 85–102). Washington, DC.

International Monetary Fund. (2022). *World Economic Outlook Countering the Cost of Living Crisis.* https://www.imf.org/en/Publications/WEO/Issues/2022/10/11/world-economic-outlook-october-2022

Ioannou, I., & Serafeim, G. (2012). What drives corporate social performance? The role of nation-level institutions. *Journal of International Business Studies, 43,* 834-864. https://doi.org/10.1057/jibs.2012.26

IFRS Foundation. (2023, July). *IFRS Foundation welcomes culmination of TCFD work and transfer of TCFD monitoring responsibilities to ISSB from 2024.* https://www.ifrs.org/news-and-events/news/2023/07/foundation-welcomes-tcfd-responsibilities-from-2024/

ISSB. (2022a). *[Draft] IFRS S2 Climate-related Disclosures.* IFRS Sustainability. https://www.ifrs.org/content/dam/ifrs/project/climate-related-disclosures/issb-exposure-draft-2022-2-climate-related-disclosures.pdf

ISSB. (2022b). *[Draft] IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information.* IFRS Sustainability. https://www.ifrs.org/content/dam/ifrs/project/general-sustainability-related-disclosures/exposure-draft-ifrs-s1-general-requirements-for-disclosure-of-sustainability-related-financial-information.pdf

Jaggi, B., Allini, A., Macchioni, R., & Zagaria, C. (2018). The Factors Motivating Voluntary Disclosure of Carbon Information: Evidence Based on Italian Listed Companies. *Organization & Environment*, *31*(2), 178–202. https://doi.org/10.1177/1086026617705282

Jung, J., Herbohn, K., & Clarkson, P. (2018). Carbon Risk, Carbon Risk Awareness and the Cost of Debt Financing. *Journal of Business Ethics*, *150*(4), 1151–1171. https://doi.org/10.1007/s10551-016-3207-6

Khoo, E. S., Lim, Y., Lu, L. Y., Monroe, G. S. (2022). Corporate social responsibility performance and the reputational incentives of independent directors. *Journal of Business Finance & Accounting, 49*(5-6), 841-881. https://doi.org/10.1111/jbfa.12569

Kölbel, J., Leippold, M., Rillaerts, J., & Wang, Q. (2022). Ask BERT: How Regulatory Disclosure of Transition and Physical Climate Risks Affects the CDS Term Structure. *Journal of Financial Econometrics.* https://doi.org/10.1093/jjfinec/nbac027

Krueger, P., Sautner, Z., Starks, L. T., & Karolyi, A. (2020). The Importance of Climate Risks for Institutional Investors. *The Review of Financial Studies*, *33*(3), 1067–1111. https://doi.org/10.1093/rfs/hhz137

Lang, M., Lins, K. V., & Maffett, M. (2012). Transparency, Liquidity, and Valuation: International Evidence on When Transparency Matters the Most. *Journal of Accounting Research, 50*(3), 729-774. 10.1111/j.1475-679X.2012.00442.x

Li, Q., Shan, H., Tang, Y., & Yao, V. (2024). Corporate Climate Risk: Measurements and Responses. *The Review of Financial Studies,* 1-53. https://doi.org/10.1093/rfs/hhad094

Liesen, A., Hoepner, A. G., Patten, D. M., & Figge, F. (2015). Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe.

Accounting, Auditing & Accountability Journal, *28*(7), 1047–1074. https://doi.org/10.1108/AAAJ-12-2013-1547

Lennox, C. S., J. R. Francis, & Wang, Z. (2012). Selection models in accounting research. *The Accounting Review, 87*(2), 589-616. https://doi.org/10.2308/accr-10195

Lewellen, J. (1999). The time-series relation among expected return, risk, and book-to-market. *Journal of Financial Economics, 54*(1), 5-43. https://doi.org/10.1016/S0304-405X(99)00030-6

Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-Value Effects of Carbon Emissions and Carbon Disclosures. *The Accounting Review*, *89*(2), 695–724. https://doi.org/10.2308/accr-50629

Matsumura, E. M., Prakash, R., & Vera-Munoz, S. C. (2022). Climate-risk materiality and firm risk. *Review of Accounting Studies.* https://doi.org/10.1007/s11142-022-09718-9

McMullin, J. L., & Schonberger, B. (2020). Entropy-balanced accruals. *Review of Accounting Studies, 25,* 84-119. https://doi.org/10.1007/s11142-019-09525-9

McMullin, J. L., & Schonberger, B. (2022). When Good Balance Goes Bad: A Discussion of Common Pitfalls When Using Entropy Balancing. *Journal of Financial Reporting, 7*(1), 167-197. 10.2308/JFR-2021-007

Metzner, M., & Mikes, A. (2021). *'Difficult Political Work': Strategic Responses to Climate Risk by Carbon-intensive Corporations*. SSRN Working Paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3868564

Milgrom, P. R. (1981). Good News and Bad News: Representation Theorems and Applications. *The Bell Journal of Economics*, *12*(2), 380–391. https://doi.org/10.2307/3003562

Mooney, A., & Nauman, B. (2020, January 20). Larry Fink rules on the best global standards for climate risk reporting. *Financial Times*. https://www.ft.com/content/fc51227b-9d64-4e5a-b1e2-f6c07f4caa58

Ohlson, J. A. (1995). Earnings, Book Values, and Dividends in Equity Valuation. *Contemporary Accounting Research, 11*(2), 661-687. https://doi.org/10.1111/j.1911-3846.1995.tb00461.x

OMB Research. (2021). *Defined Benefit Survey 2020: Prepared for The Pensions Regulator by OMB Research*. https://www.thepensionsregulator.gov.uk/en/media-hub/press-releases/2021-press-releases/db-schemes-must-act-on-climate-change-preparations-survey-shows

Ott, C., Schiemann, F., & Günther, T. (2017). Disentangling the determinants of the response and the publication decisions: The case of the Carbon Disclosure Project. *Journal of Accounting and Public Policy*, *36*(1), 14–33. https://doi.org/10.1016/j.jaccpubpol.2016.11.003

Peters, R. H., & Taylor, L. A. (2017). Intangible capital and the investment-q relation. *Journal of Financial Economics, 123*(2), 251-272. https://doi.org/10.1016/j.jfineco.2016.03.011

Raghunandan, A., & Rajgopal, S. (2022). Do ESG funds make stakeholder-friendly investments? *Review of Accounting Studies, 27*, 822-863. https://doi.org/10.1007/s11142-022-09693-1

Reid, E. M., & Toffel, M. W. (2009). Responding to public and private politics: Corporate disclosure of climate change strategies. *Strategic Management Journal*, *30*(11), 1157–1178. https://doi.org/10.1002/smj.796

Sautner, Z., Van Lent, L., Vilkov, G., & Zhang, R. (2023). Firm-Level Climate Change Exposure. *Journal of Finance, 78*(3), 1449-1498. https://doi.org/10.1111/jofi.13219

Schiemann, F., & Sakhel, A. (2019). Carbon Disclosure, Contextual Factors, and Information Asymmetry: The Case of Physical Risk Reporting. *European Accounting Review*, *28*(4), 791–818. https://doi.org/10.1080/09638180.2018.1534600

Schnabel, I. (2020, September 28). *When markets fail – the need for collective action in tackling climate change*. European Central Bank. https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200928_1~268b0b672f.en.html

Segal, M. (2021, May 13). Canada Launches Sustainable Finance Action Council, Aims to Enhance Climate Disclosure. *ESG Today*. https://www.esgtoday.com/canada-launches-sustainable-finance-action-council-aims-to-enhance-climate-disclosure/

Stroebel, J., & Wurgler, J. (2021). *What Do You Think about Climate Finance?* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3898013&dgcid=ejournal_htmlemail_capital:markets:asset:pricing:valuation:ejournal_abstractlink

TCFD. (2017). *Recommendations of the Task Force on Climate-related Financial Disclosures: Final Report*. https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf

TCFD. (2022). *Task Force on Climate-related Financial Disclosures 2022 Status Report.* https://assets.bbhub.io/company/sites/60/2022/10/2022-TCFD-Status-Report.pdf

U.S. SEC. (2022, March 22). *SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors* [Press release]. https://www.sec.gov/news/press-release/2022-46

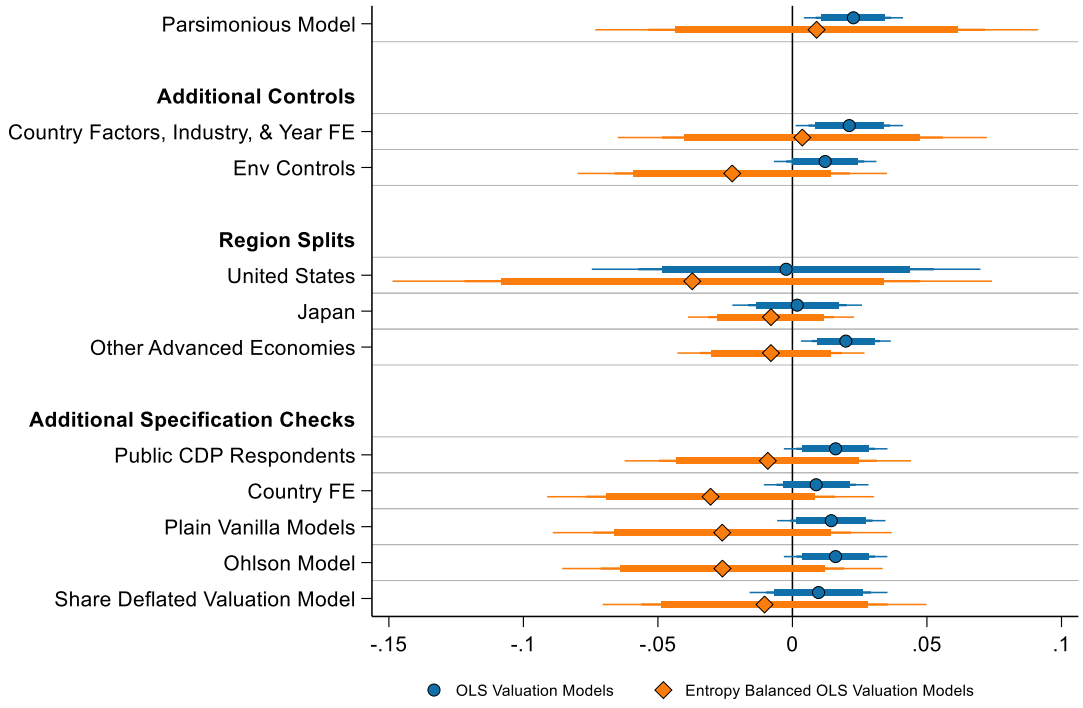
Verrecchia, R. E. (1983). Discretionary disclosure. *Journal of Accounting and Economics*, *5*, 179–194. https://doi.org/10.1016/0165-4101(83)90011-3

Yellen, J. L. (2021, April 21). *Secretary of the Treasury Janet L. Yellen's Remarks to the Institute of International Finance*. U.S. Department of the Treasury. https://home.treasury.gov/news/press-releases/jy0139

Figure 1: Specification Checks CDP Disclosure Models

Figure 1 summarizes coefficient loadings from variants of our balance-sheet valuation and bid-ask spread models on an indicator variable taking the value of one if a firm discloses to the CDP. Panel A shows results for valuation models and Panel B for spread models. The blue (circle) bars represent point estimates and confidence intervals from OLS regressions, and the orange (diamond) bars represent point estimates and confidence intervals from entropy-balanced OLS models using our model (1) variables. The thin, medium, and thick bars respectively represent 99%, 95%, and 90% confidence intervals. The parsimonious balance sheet valuation model includes the *CDP* disclosure variable and *Asset*, *Liab*, and *OpInc*. The parsimonious spread model includes the *CDP* disclosure variable together with *logMVE*, *logRetVar*, and *logShareTurn*. The coefficients under the "Additional Controls" header summarize results from adding country factors, industry, and year fixed effects, and from additionally adding the environmental control variables *EnvScore*, *logCO2e*, and *CCExposure* to the parsimonious baseline model. The coefficients under the "Region Splits" header summarize results of splitting the sample on US and non-US firms, and the coefficients under the "Additional Specification Checks" header summarize results of specification checks for the full valuation and bid-ask spread model specifications. *Public CDP Respondents* alternatively defines the *CDP* disclosure variable as one for those firms that disclose publicly to the CDP only and zero otherwise. *Country FE* switches out the country factors for country indicator variables, *Plain Vanilla Models* replace *IntangStock* for R&D/AT and leave all other variables unadjusted for the capitalization and amortization of internally generated intangible assets, *Ohlson Model* replaces the balance-sheet valuation model for an Ohlson (1995) specification, and the *Share Deflated Valuation Model* scales our valuation model variables by shares outstanding. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

Panel A: Specification checks CDP disclosure valuation models



Panel B: Specification checks CDP disclosure spread models

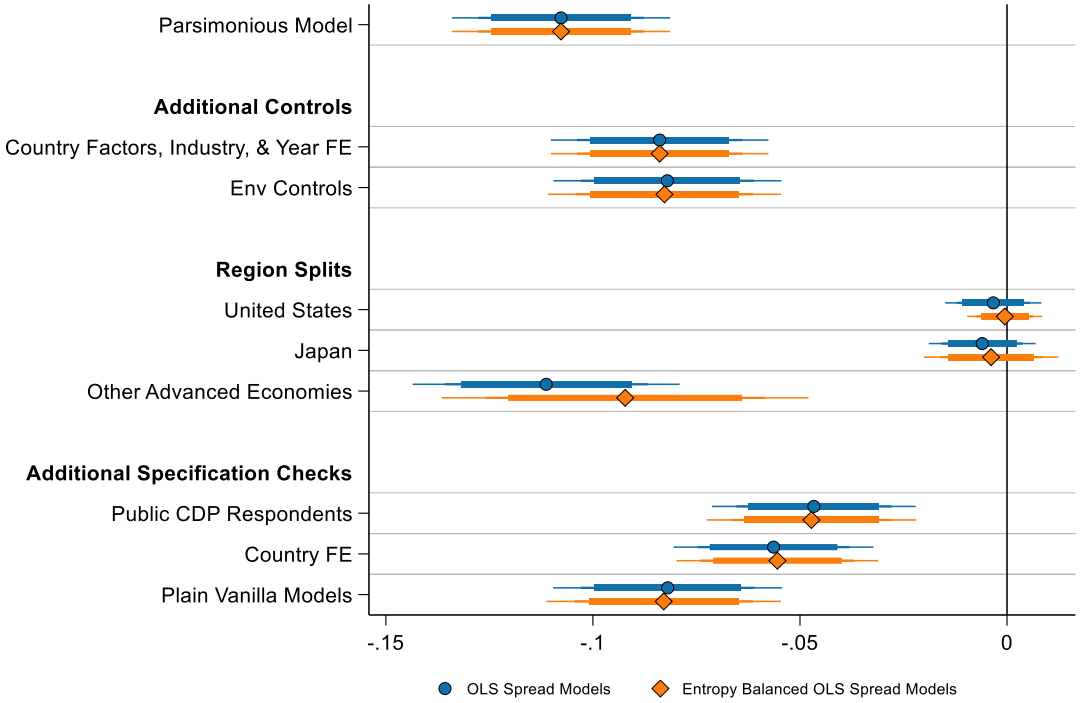
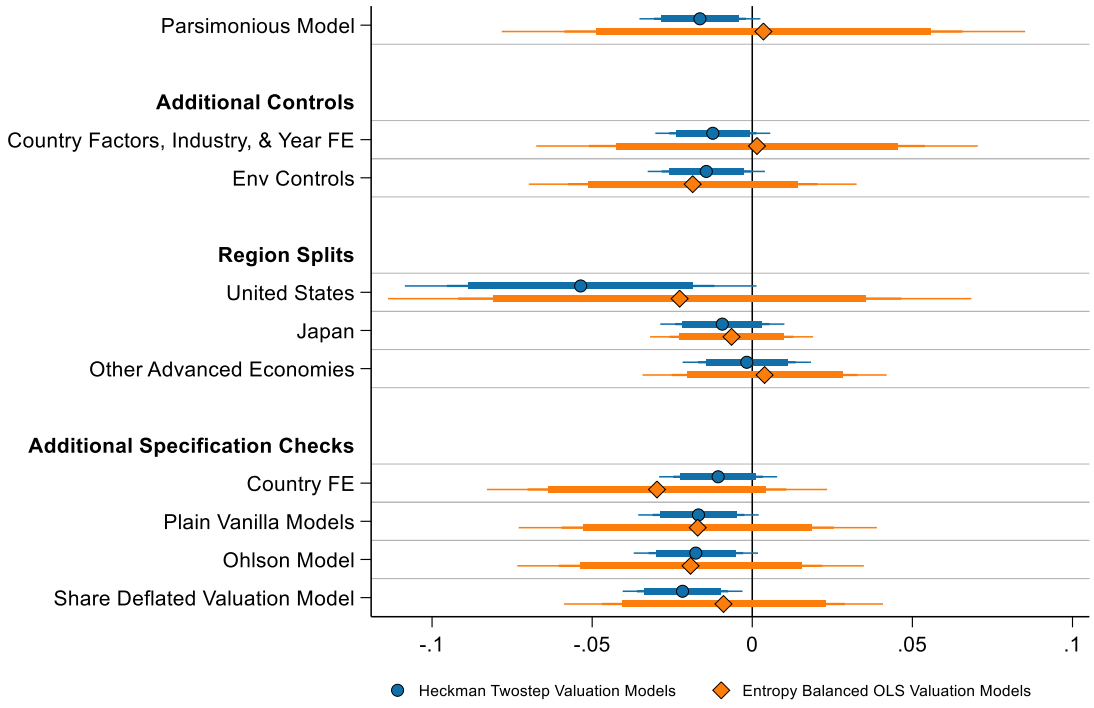


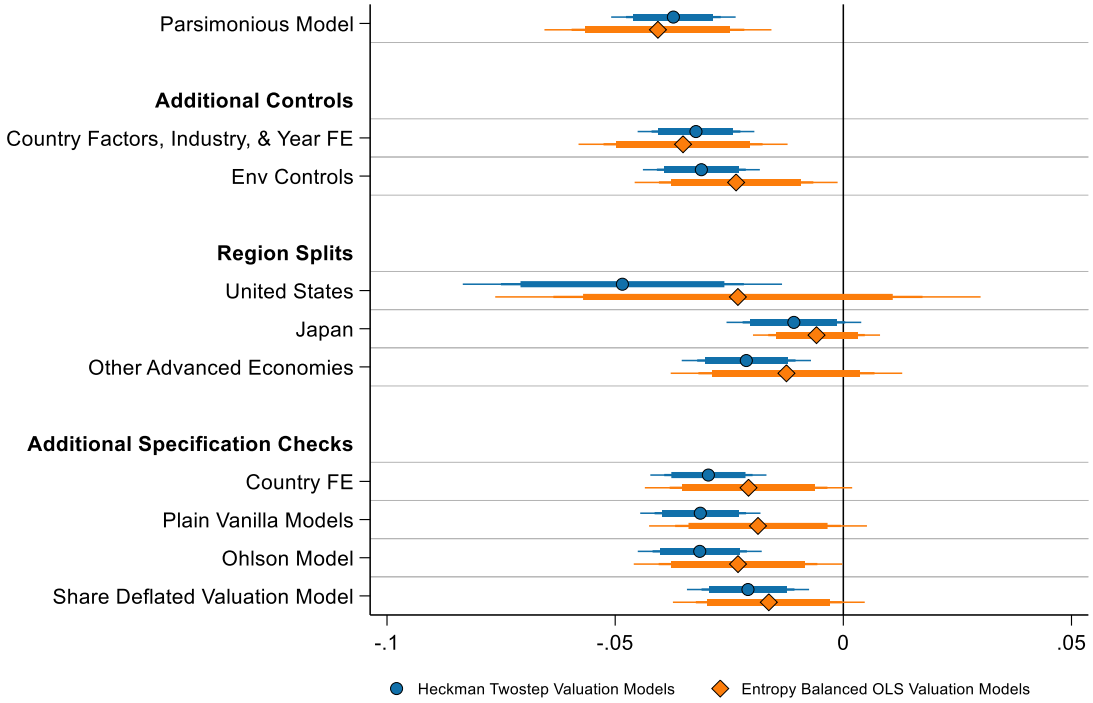
Figure 2: Specification Checks Climate Risk and Opportunity Valuation Models

Figure 2 Panel A summarizes coefficient loadings from variants of our balance-sheet valuation models on an indicator variable taking the value of one if a firm discloses TCFD-aligned climate risk information and zero otherwise. Panel B shows the results for industry-year adjusted *NTransRisk*, Panel C for *NPhysRisk*, and Panel D for *NOpportunities*. The blue (circle) bars represent point estimates and confidence intervals from twostep consistent Heckman model estimations and the orange (diamond) bars represent point estimates and confidence intervals from entropy-balanced OLS models. The thin, medium, and thick bars respectively represent 99%, 95%, and 90% confidence intervals. The parsimonious balance sheet valuation model includes *Asset*, *Liab*, and *OpInc*. The coefficients under the "Additional Controls" header summarize results from adding country factors, industry, and year fixed effects, and from additionally adding the environmental control variables *EnvScore*, *logCO2e*, and *CCExposure* to the parsimonious baseline model. The coefficients under the "Region Splits" header summarize results of splitting the sample on US and non-US firms, and the coefficients under the "Additional Specification Checks" header summarize results of specification checks for the full valuation model specifications. *Country FE* switches out the country factors for country indicator variables, *Plain Vanilla Models* replace *IntangStock* for R&D/AT and leave all other variables unadjusted for the capitalization and amortization of internally generated intangible assets, *Ohlson Model* replaces the balance-sheet valuation model for an Ohlson (1995) specification, and the *Share Deflated Valuation Model* scales our valuation model variables by shares outstanding. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

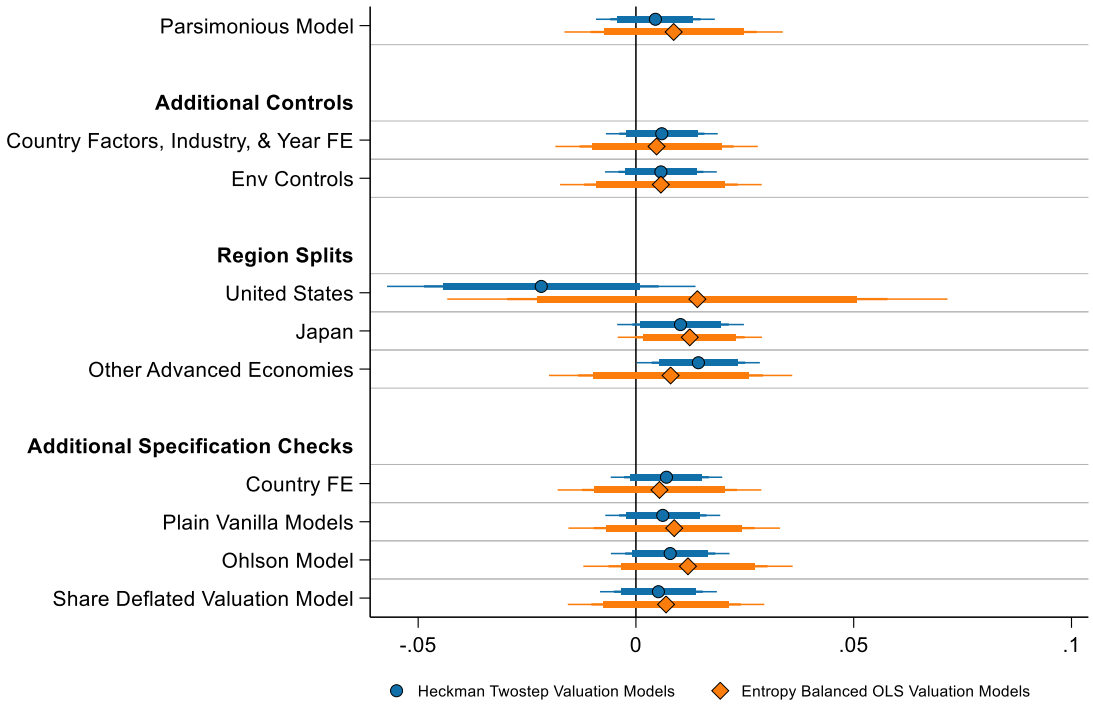
Panel A: Specification checks *CR* disclosure valuation models



Panel B: Specification checks *NTransRisk* valuation models



Panel C: Specification checks *NPhysRisk* valuation models



Panel D: Specification checks *NOpportunity* valuation models

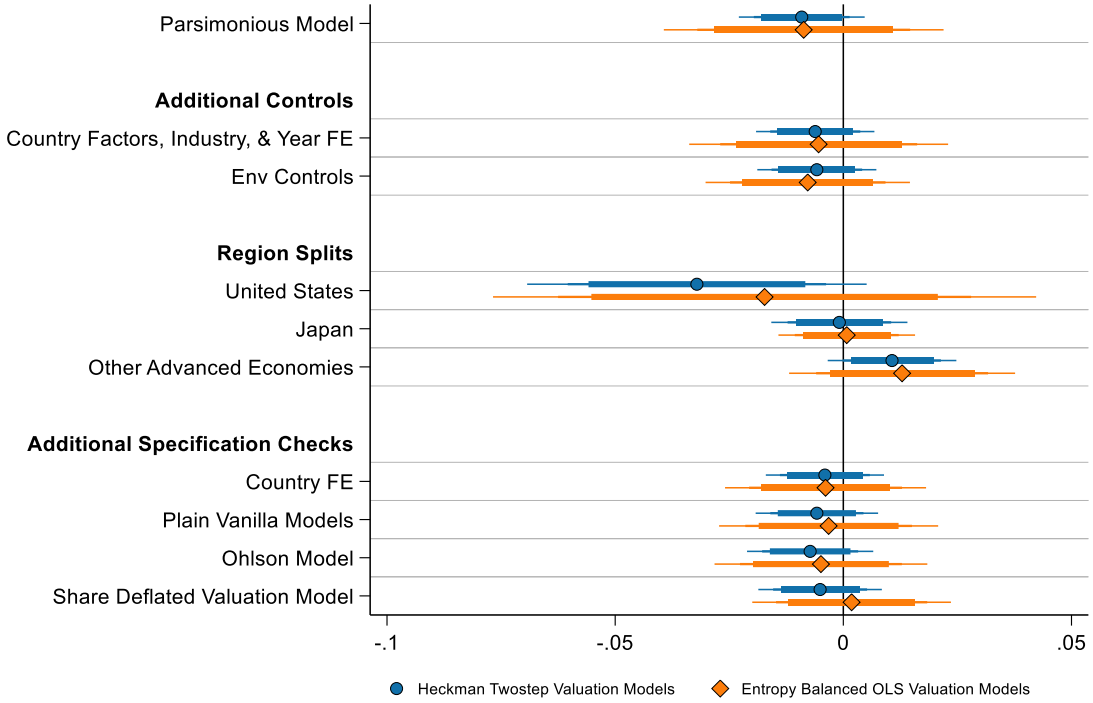
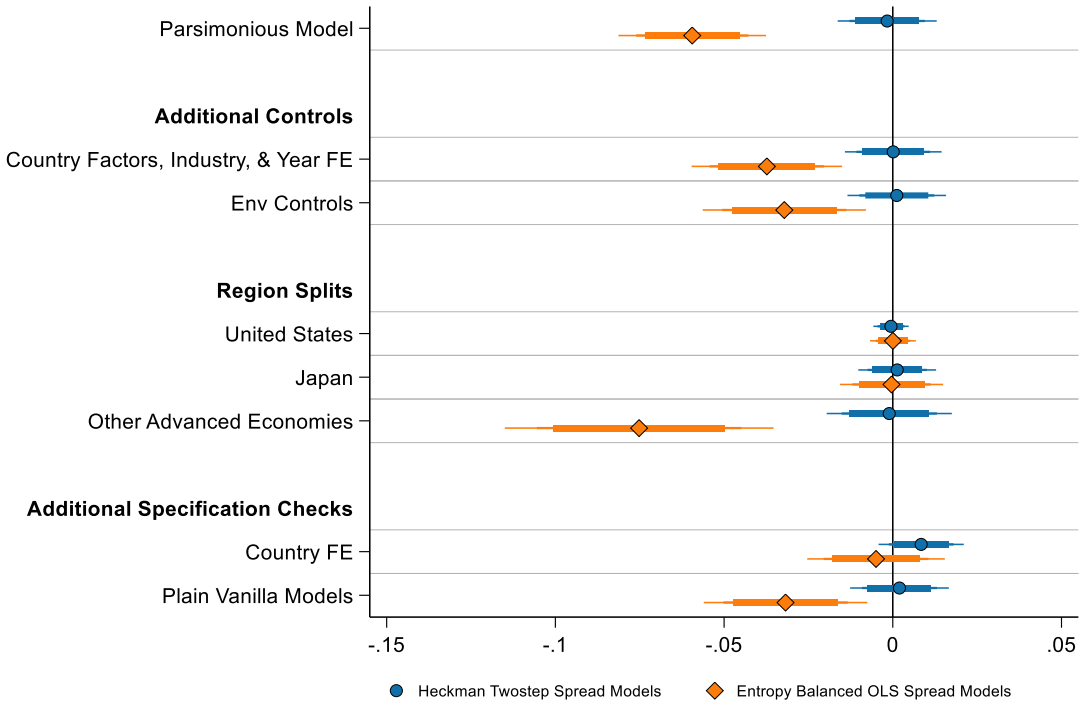


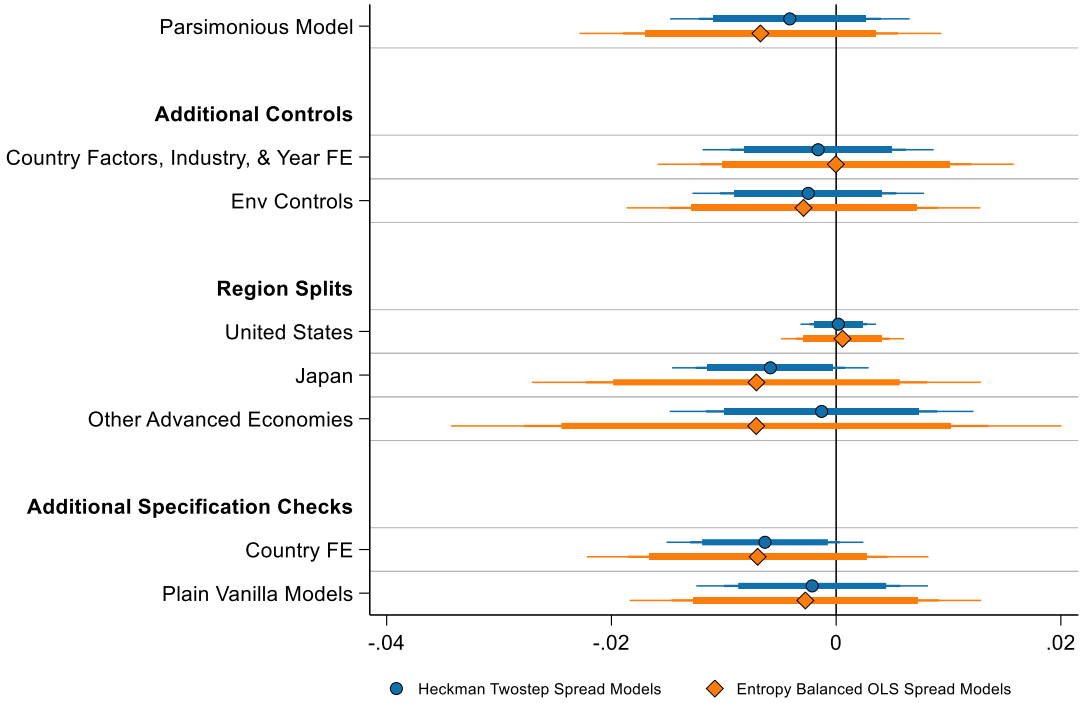
Figure 3: Specification Checks Climate Risk and Opportunity Bid-Ask Spread Models

Figure 3 Panel A summarizes coefficient loadings from variants of our bid-ask spread models on an indicator variable taking the value of one if a firm discloses TCFD-aligned climate risk information and zero otherwise. Panel B shows the results for industry-year adjusted *NTransRisk*, Panel C for *NPhysRisk*, and Panel D for *NOpportunities*. . The blue (circle) bars represent point estimates and confidence intervals from twostep consistent Heckman model estimations and the orange (diamond) bars represent point estimates and confidence intervals from entropy-balanced models. The thin, medium, and thick bars respectively represent 99%, 95%, and 90% confidence intervals. The parsimonious spread model includes *logMVE, logRetVar,* and *logShareTurn.* The coefficients under the "Additional Controls" header summarize results from adding additional financial controls, country factors, industry, and year fixed effects, and from additionally adding the environmental control variables *EnvScore, logCO2e,* and *CCExposure* to the parsimonious baseline model. The coefficients under the "Region Splits" header summarize results of splitting the sample on US and non-US firms, and the coefficients under the "Additional Specification Checks" header summarize results of specification checks for the full spread model specifications. *Country FE* switches out the country factors for country indicator variables, and *Plain Vanilla Models* replace *IntangStock* for R&D/AT and leave all other variables unadjusted for the capitalization and amortization of internally generated intangible assets. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

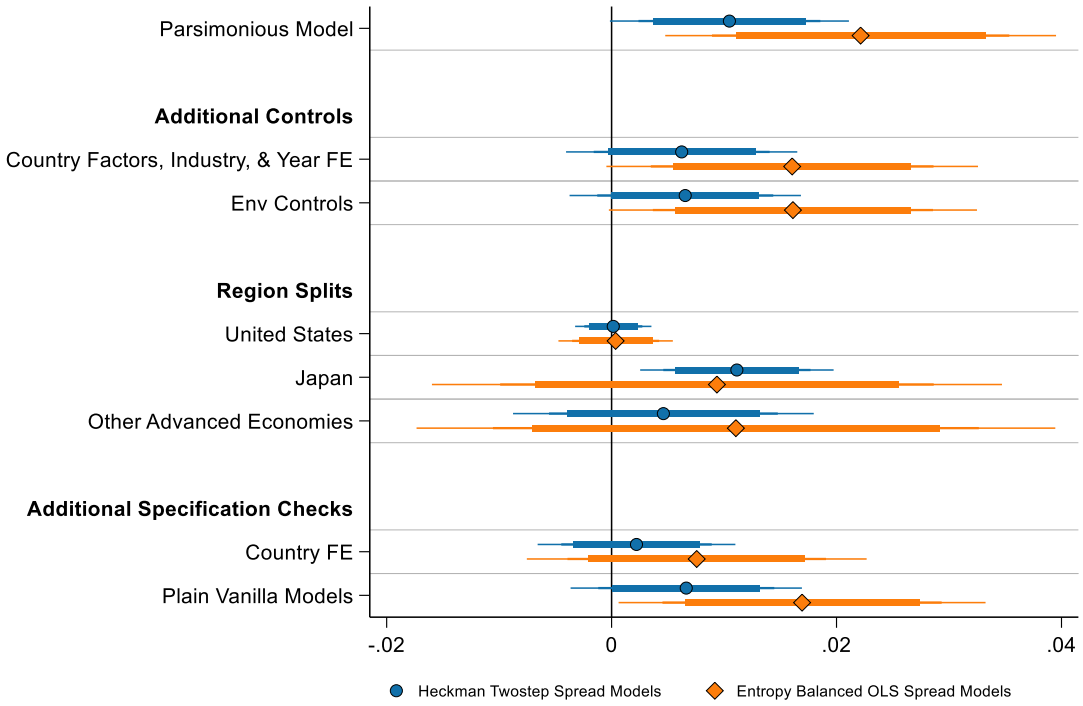
Panel A: Specification checks *CR* spread models



Panel B: Specification checks *NTransRisk* spread models



Panel C: Specification checks *NPhysRisk* spread models



Panel D: Specification checks *NOpportunity* spread models

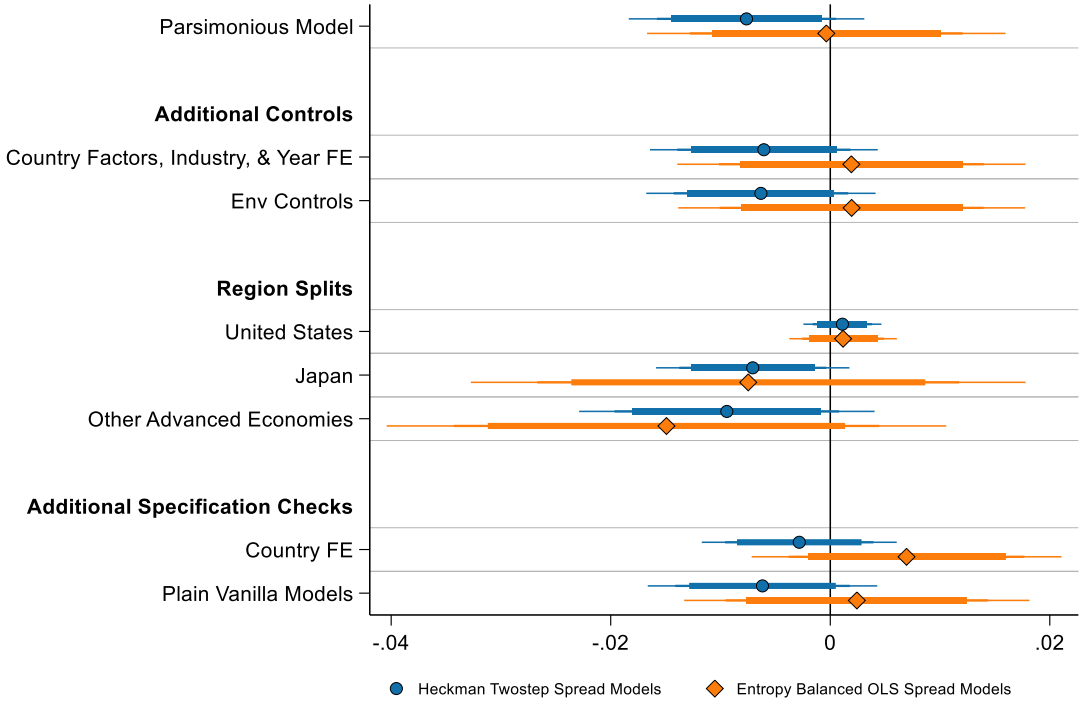
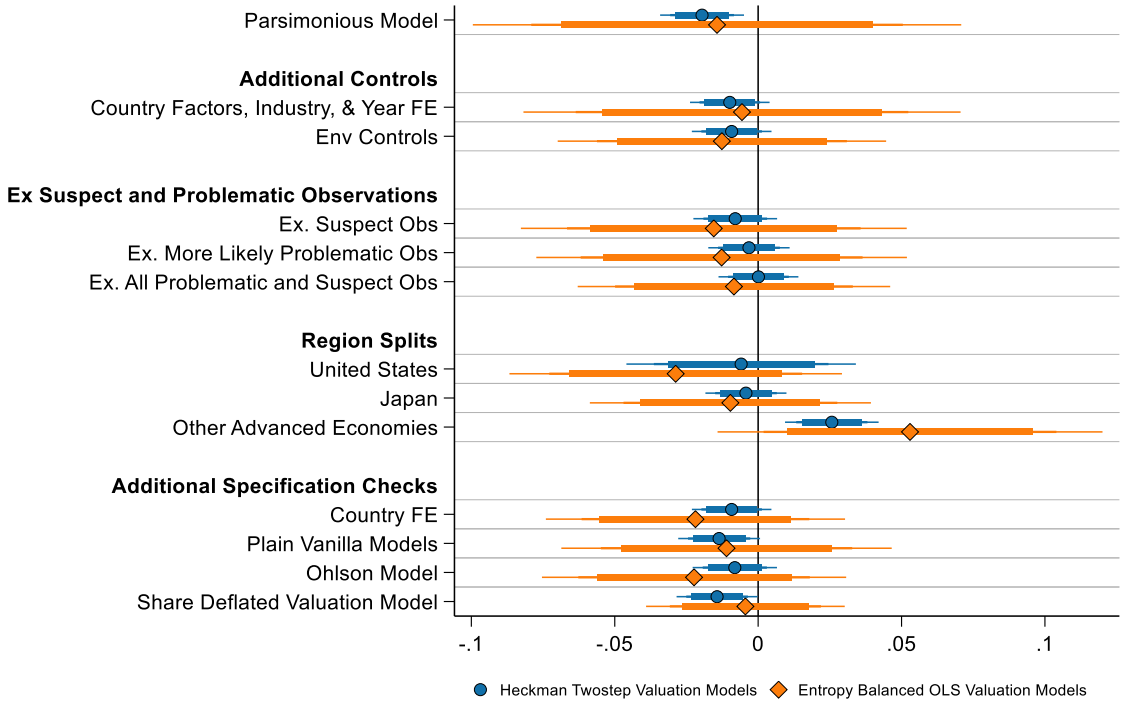


Figure 4: Specification Checks Valuation Models Financial Impact Estimates of Risk and Opportunities

Figure 2 Panel A summarizes coefficient loadings from variants of our balance-sheet valuation models on financial impact estimates of climate-related risks. Panel B shows the results for financial impact estimates of opportunities. The blue (circle) bars represent point estimates and confidence intervals from twostep consistent Heckman model estimations and the orange (diamond) bars represent point estimates and confidence intervals from entropy-balanced models. The thin, medium, and thick bars respectively represent 99%, 95%, and 90% confidence intervals. The parsimonious balance sheet valuation model includes *Asset, Liab,* and *OpInc.* The coefficients under the "Additional Controls" header summarize results from adding country factors, industry, and year fixed effects, and from additionally adding the environmental control variables *EnvScore, logCO2e,* and *CCExposure* to the parsimonious baseline model. The coefficients under the "Excluding Suspect and Problematic Observations" header summarize results from specifications that iteratively drop suspect and different categories of potentially problematic observations (see Appendix A). The coefficients under the "Region Splits" header summarize results of splitting the sample on US and non-US firms, and the coefficients under the "Additional Specification Checks" header summarize results of specification checks for the full valuation model specifications. *Country FE* switches out the country factors for country indicator variables, *Plain Vanilla Models* replace *IntangStock* for R&D/AT and leave all other variables unadjusted for the capitalization and amortization of internally generated intangible assets, *Ohlson Model* replaces the balance-sheet valuation model for an Ohlson (1995) specification, and the *Share Deflated Valuation Model* scales our valuation model variables by shares outstanding. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

Panel A: Balance-sheet valuation models financial impact estimates of risks



Panel B: Balance-sheet valuation models financial impact estimates of opportunities

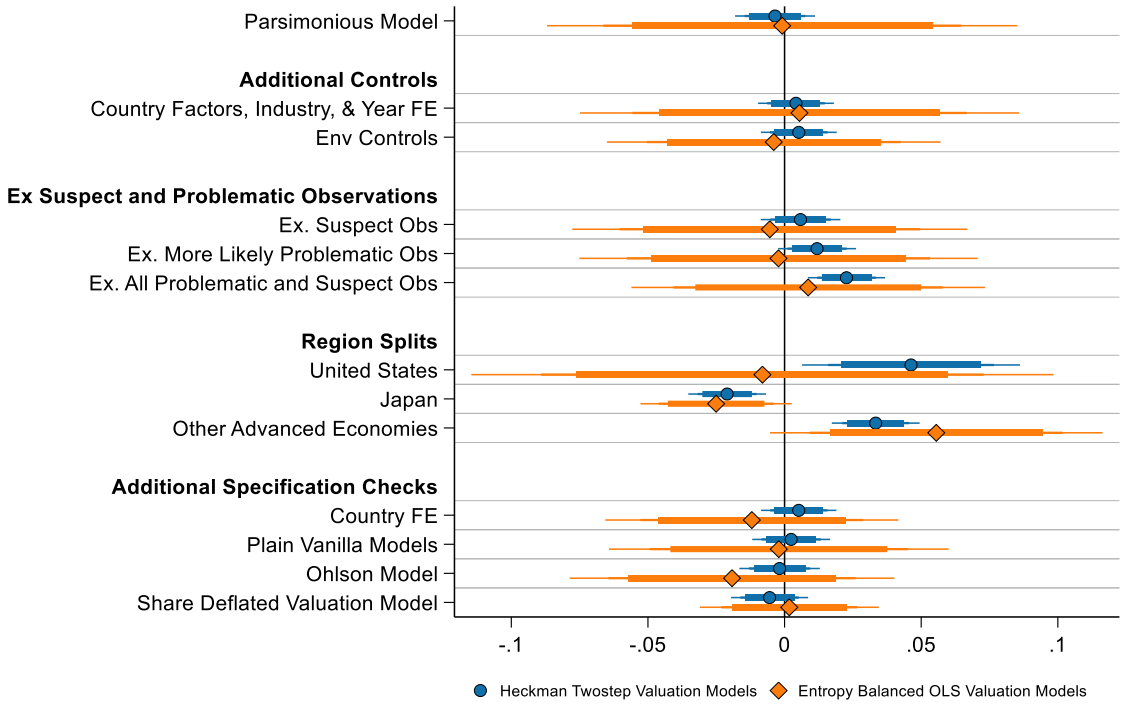
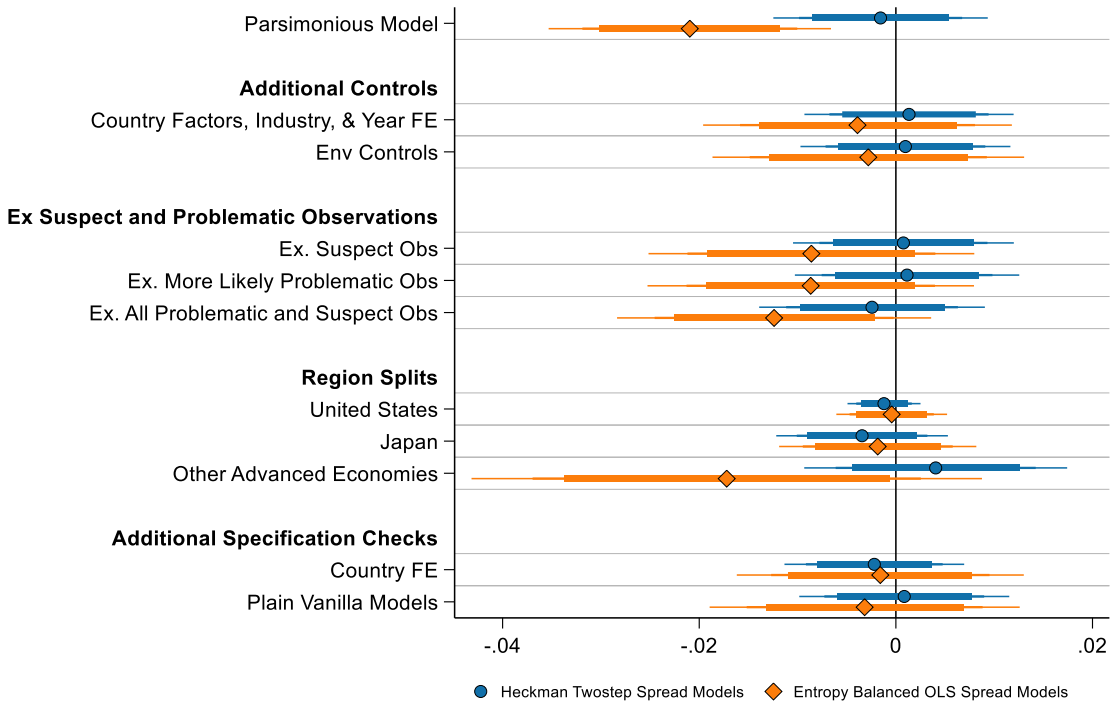


Figure 5: Specification Checks Bid-Ask Spread Models Financial Impact Estimates of Risk and Opportunities

Figure 5 Panel A summarizes coefficient loadings from variants bid-ask spread models on financial impact estimates of climate-related risks. Panel B shows the results for financial impact estimates of opportunities. The blue (circle) bars represent point estimates and confidence intervals from twostep consistent Heckman model estimations and the orange (diamond) bars represent point estimates and confidence intervals from entropy-balanced models. The thin, medium, and thick bars respectively represent 99%, 95%, and 90% confidence intervals. The parsimonious spread model includes *logMVE*, *logRetVar*, and *logShareTurn*. The coefficients under the "Additional Controls" header summarize results from adding additional financial controls, country factors, industry, and year fixed effects, and from additionally adding the environmental control variables *EnvScore*, *logCO2e*, and *CCExposure* to the parsimonious baseline model. The coefficients under the "Excluding Suspect and Problematic Observations" header summarize results from specifications that iteratively drop suspect and different categories of potentially problematic observations (see Appendix A). The coefficients under the "Region Splits" header summarize results of splitting the sample on US and non-US firms, and the coefficients under the "Additional Specification Checks" header summarize results of specification checks for the full spread model specifications. *Country FE* switches out the country factors for country indicator variables, and *Plain Vanilla Models* replace *IntangStock* for R&D/AT and leave all other variables unadjusted for the capitalization and amortization of internally generated intangible assets. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

Panel A: Bid-ask spread models financial impact estimates of risks



Panel B: Bid-ask spread models financial impact estimates of opportunities

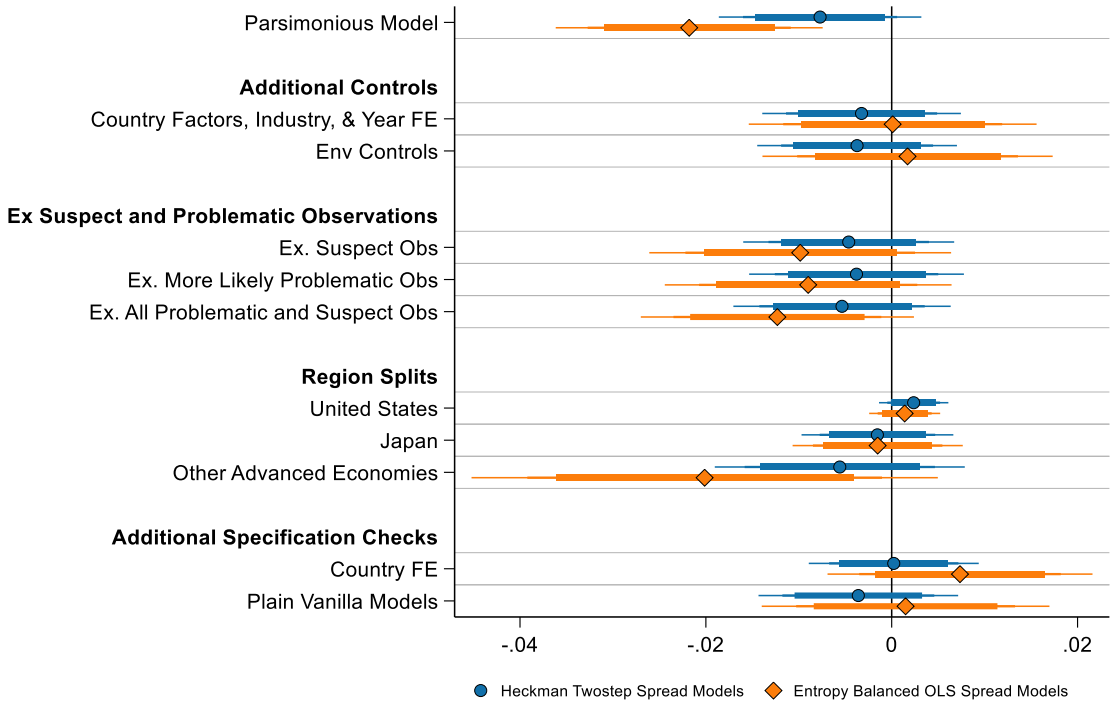


Table 1: Sample Determination

Table 1 presents the sample selection process, starting from the full CDP Survey Response Database. We drop firm-years for which ISINs are unavailable, but manually replace missing ISINs if a firm reports an ISIN for at least one of the disclosure years and reports a ticker for all of the disclosure years (i.e., the firm is listed but neglected to consistently report an ISIN). We then manually check all firm-years for which multiple ISINs are reported (e.g., because of multiple securities, subsidiaries, or changing ISINs over the disclosure year) and keep the ISIN that corresponds with the consolidated reporting entity based on Worldscope data availability and company names. We next manually check all duplicate ISIN-year observations and keep data for consolidated entities and for which company names correspond with Worldscope. We investigate all firm-years with fiscal year end changes and drop those firm-disclosure years that cannot be definitively matched to corresponding fiscal year data in Worldscope. We keep firms headquartered in advanced economies based on the IMF World Economic Outlook report (International Monetary Fund, 2022), and further drop all firms in FF48 industry groups 44, 45, 46, and 47. Following Edmans et al. (2023), and to ensure that our sample consists exclusively of consolidated entities, we drop all firms that reported to the CDP using an ISIN that is not their major security, and we further drop firms with negative *BTM* (e.g., Fama & French, 1995; Lewellen, 1999). Finally, we require data availability for all financial and market data used in our analyses and we exclude countries with less than 20 firm-year observations and/or less than 10 CDP responses (e.g., Lang et al., 2012). Our final sample consists of 17,272 firm-year observations.

CDP Survey Response Database	
Number of firm-year observations for disclosure years 2018 - 2022	35,197
Dropping (data collection and merging):	
Missing ISINs	-2,326
Duplicate firm-year observations	-30
Not covered in Worldscope	-2,193
Changing fiscal year ends	-23
Number of observations after data collection and merging	30,625
Dropping (additional sample selection criteria):	
Not headquartered in advanced economies	-8,820
Financials and real estate	-3,761
ISIN is not firms' major security listing	-56
Missing financial statement and market data	-411
Negative BTM	-200
Less than 20 country observations	-23
Less than 10 country CDP responses	-82
Number of sample firm-years	17,272

Table 2: Sample Composition and CDP Response Rates

Panel A: Sample Companies by Country of Headquarters

	Disclosure Year					
NATION	2018	2019	2020	2021	2022	Total
AUSTRALIA	135	137	137	139	136	684
AUSTRIA	25	23	24	23	22	117
BELGIUM	47	44	42	38	40	211
CANADA	146	145	143	149	155	738
DENMARK	28	29	29	32	33	151
FINLAND	43	39	37	39	39	197
FRANCE	197	197	192	191	205	982
GERMANY	164	144	142	146	156	752
GREECE	7	5	7	8	9	36
HONG KONG	84	94	96	99	104	477
IRELAND	38	35	35	36	37	181
ISRAEL	12	12	16	16	21	77
ITALY	70	61	63	63	65	322
JAPAN	481	476	476	499	1639	3571
KOREA (SOUTH)	175	180	177	198	277	1007
NETHERLANDS	52	53	49	53	52	259
NEW ZEALAND	36	34	37	71	70	248
NORWAY	36	36	37	42	43	194
PORTUGAL	29	26	28	22	25	130
SINGAPORE	26	27	26	29	31	139
SPAIN	62	60	63	62	64	311
SWEDEN	75	75	86	92	93	421
SWITZERLAND	99	98	99	97	98	491
TAIWAN	109	108	110	112	172	611
UNITED KINGDOM	312	301	288	280	271	1452
UNITED STATES	594	605	640	663	1011	3513
Total	3082	3044	3079	3199	4868	17272

Panel B: CDP Survey Response Rate by Country of Headquarters

NATION	Disclosure Year					
	2018	2019	2020	2021	2022	Total
AUSTRALIA	.319	.314	.307	.309	.338	.317
AUSTRIA	.44	.522	.583	.696	.909	.624
BELGIUM	.298	.341	.429	.632	.6	.45
CANADA	.521	.559	.622	.644	.613	.592
DENMARK	.464	.517	.69	.656	.727	.616
FINLAND	.86	.897	.946	.923	.897	.904
FRANCE	.386	.421	.453	.539	.561	.473
GERMANY	.427	.507	.549	.623	.635	.547
GREECE	.286	.4	.286	.625	.889	.528
HONG KONG	.238	.277	.302	.354	.452	.329
IRELAND	.5	.6	.743	.778	.784	.68
ISRAEL	.333	.333	.375	.375	.429	.377
ITALY	.486	.525	.603	.651	.723	.596
JAPAN	.609	.666	.7	.758	.585	.638
KOREA (SOUTH)	.274	.267	.311	.374	.426	.341
NETHERLANDS	.538	.547	.592	.623	.635	.587
NEW ZEALAND	.278	.382	.486	.268	.3	.327
NORWAY	.639	.722	.784	.81	.837	.763
PORTUGAL	.276	.346	.357	.455	.4	.362
SINGAPORE	.5	.519	.538	.517	.548	.525
SPAIN	.548	.567	.603	.71	.688	.624
SWEDEN	.533	.547	.581	.62	.667	.594
SWITZERLAND	.414	.408	.424	.485	.582	.462
TAIWAN	.486	.565	.6	.643	.744	.622
UNITED KINGDOM	.503	.535	.576	.682	.749	.605
UNITED STATES	.608	.643	.659	.724	.657	.659
Total	.496	.534	.57	.625	.606	.571

Panel C: Sample Companies by FF12 Industry

Fama-French industry code (12 industries)	Disclosure Year					
	2018	2019	2020	2021	2022	Total
Consumer Non-Durables	231	228	240	240	370	1309
Consumer Durables	124	120	118	128	192	682
Manufacturing	472	462	457	477	708	2576
Oil, Gas, and Coal	150	142	137	132	133	694
Chemicals and Allied Products	155	157	153	156	245	866
Business Equipment	465	465	496	531	965	2922
Telephone and Television	89	87	82	79	100	437
Utilities	163	165	159	166	184	837
Wholesale, Retail, Service	363	343	348	355	642	2051
Healthcare, Pharma	196	201	205	228	313	1143
Other	674	674	684	707	1016	3755
Total	3082	3044	3079	3199	4868	17272

Panel D: CDP Survey Response Rate by FF12 Industry

Fama-French industry code (12 industries)	Disclosure Year					
	2018	2019	2020	2021	2022	Total
Consumer Non-Durables	.532	.601	.633	.717	.659	.633
Consumer Durables	.581	.633	.695	.734	.724	.679
Manufacturing	.557	.58	.635	.69	.708	.641
Oil, Gas, and Coal	.393	.444	.511	.553	.617	.5
Chemicals and Allied Products	.626	.669	.739	.808	.755	.723
Business Equipment	.523	.551	.583	.612	.594	.577
Telephone and Television	.562	.621	.683	.734	.64	.645
Utilities	.583	.606	.692	.723	.701	.662
Wholesale, Retail, Service	.397	.464	.483	.552	.505	.483
Healthcare, Pharma	.423	.458	.463	.465	.454	.453
Other	.444	.466	.484	.566	.558	.509
Total	.496	.534	.57	.625	.606	.571

Panel E: TCFD Opportunities and/or Climate Risk Disclosure Rate by Country of Headquarters

NATION	Disclosure Year					
	2018	2019	2020	2021	2022	Total
AUSTRALIA	.2	.146	.146	.187	.184	.173
AUSTRIA	.36	.391	.458	.478	.5	.436
BELGIUM	.17	.182	.262	.368	.375	.265
CANADA	.356	.414	.476	.537	.503	.458
DENMARK	.393	.483	.517	.625	.576	.523
FINLAND	.651	.769	.838	.872	.795	.782
FRANCE	.274	.294	.354	.393	.38	.339
GERMANY	.226	.299	.338	.397	.404	.331
GREECE	.143	.2	.143	.375	.444	.278
HONG KONG	.095	.117	.146	.152	.192	.143
IRELAND	.342	.371	.457	.528	.568	.453
ISRAEL	.167	.167	.125	.25	.286	.208
ITALY	.4	.443	.476	.508	.554	.475
JAPAN	.43	.506	.557	.609	.336	.439
KOREA (SOUTH)	.211	.233	.254	.303	.3	.265
NETHERLANDS	.308	.34	.367	.396	.5	.382
NEW ZEALAND	.25	.324	.297	.183	.171	.226
NORWAY	.583	.722	.73	.738	.744	.706
PORTUGAL	.241	.231	.286	.409	.4	.308
SINGAPORE	.231	.296	.308	.31	.29	.288
SPAIN	.419	.483	.46	.532	.594	.498
SWEDEN	.427	.467	.488	.5	.57	.494
SWITZERLAND	.222	.265	.253	.278	.327	.269
TAIWAN	.275	.315	.364	.429	.442	.373
UNITED KINGDOM	.321	.372	.413	.482	.572	.428
UNITED STATES	.434	.479	.509	.543	.442	.479
Total	.34	.386	.422	.465	.397	.402

Panel F: TCFD Opportunities and/or Climate Risk Disclosure Rate by FF12 Industry

Fama-French industry code (12 industries)	Disclosure Year					
	2018	2019	2020	2021	2022	Total
Consumer Non-Durables	.359	.447	.492	.517	.416	.444
Consumer Durables	.395	.45	.508	.555	.49	.481
Manufacturing	.381	.426	.468	.545	.472	.46
Oil, Gas, and Coal	.267	.31	.358	.462	.451	.366
Chemicals and Allied Products	.458	.51	.608	.673	.559	.561
Business Equipment	.331	.372	.385	.426	.346	.369
Telephone and Television	.438	.471	.561	.544	.46	.492
Utilities	.491	.539	.585	.62	.587	.565
Wholesale, Retail, Service	.251	.324	.356	.403	.327	.331
Healthcare, Pharma	.311	.338	.356	.351	.281	.324
Other	.298	.319	.346	.383	.36	.344
Total	.34	.386	.422	.465	.397	.402

Table 3: Descriptive Statistics

Table 3 presents descriptive statistics. Institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile for each fiscal year. All variables are adjusted for the capitalization and amortization of internally generated intangibles.

	N	Mean	SD	Min	p25	Median	p75	Max
CDP	17272	.571	0.495	0	0	1	1	1
CDP public	17272	.442	0.497	0	0	0	1	1
CDP private	17272	.129	0.335	0	0	0	0	1
CR	17272	.371	0.483	0	0	0	1	1
FI	17272	.288	0.453	0	0	0	1	1
Opp	17272	.392	0.488	0	0	0	1	1
NPhysRisk_IA	17272	-.03	0.676	-1.733	-.055	0	0	3.019
NTransRisk_IA	17272	-.038	1.018	-2.601	-.003	0	0	4.781
NOpportunity IA	17272	-.027	1.052	-3.196	0	0	0	5.369
FIEstimateRisk	17272	191.946	849.896	0	0	0	4.429	8400
FIEstimateOpp	17272	436.205	2089.206	0	0	0	3.366	23583.656
MVE	17272	11666.233	27561.292	32.489	908.683	2799.89	9244.282	251621.31
Asset	17272	13860.875	28950.756	48.33	1366.68	4092.692	12096.477	203515.94
Liab	17272	7401.126	16468.338	7.576	472.021	1732.22	6081.197	114140.56
OpInc	17272	816.455	1943.882	-1696.489	49.708	206.293	701.571	15166.834
BidAsk	17272	.367	0.562	.006	.071	.177	.363	4.032
logRetVar t1	17272	2.267	0.442	1.193	1.959	2.232	2.54	3.801
logShareTurn t1	17272	.695	0.461	.021	.359	.591	.94	2.545
logSales	17272	7.71	1.719	1.807	6.666	7.787	8.843	11.686
ForeignSale	17272	.382	0.368	0	0	.317	.721	1
IndPropDisc	17272	.571	0.133	.07	.482	.568	.67	.843
Cash	17272	.131	0.117	.001	.047	.099	.176	.647
ROA	17272	.064	0.067	-.165	.03	.059	.096	.304
Loss	17272	.105	0.306	0	0	0	0	1
BTM	17272	.925	0.836	.045	.368	.678	1.207	5.822
LEV	17272	.225	0.160	0	.098	.21	.327	.694
CapEx	17272	.035	0.033	0	.012	.025	.046	.217
PPE	17272	.264	0.222	.002	.089	.2	.379	.921
IntangStock	17272	.146	0.118	0	.049	.127	.217	.543
IntangBS	17272	.155	0.181	0	.014	.075	.251	.763
InstOwn	17272	60.924	24.264	0	44.196	61.765	80.351	100
Block	17272	.938	0.242	0	1	1	1	1
GDP	17272	51.014	10.311	33.045	41.764	48.317	60.037	104.672
IndepDir	17272	47.905	33.879	0	15.385	50	80	100
SustCommittee	17272	.566	0.496	0	0	1	1	1
EMS	17272	.449	0.497	0	0	0	1	1
UNSign	17272	.195	0.396	0	0	0	0	1
SustReport	17272	.663	0.473	0	0	1	1	1
EnvScore	17272	47.326	24.748	0	29.466	47.196	67.094	99.705
logCO2e	17272	3.807	1.675	.285	2.612	3.518	5.007	8.691
CCExposure	17272	.002	0.003	0	0	.001	.003	.022

Table 4: Correlations

Table 4 presents correlation coefficients for selected variables used in our full models. Panel A presents Pearson correlations, while Panel B presents Spearman correlations. Stars indicate significant correlations at the 1% level.

Panel A: Pearson correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) CDP	1.00																	
(2) CR	0.67*	1.00																
(3) FI	0.55*	0.83*	1.00															
(4) Opp	0.70*	0.92*	0.78*	1.00														
(5) NTransRisk_IA	-0.03*	0.23*	0.17*	0.12*	1.00													
(6) NPhysRisk_IA	-0.04*	0.19*	0.17*	0.09*	0.34*	1.00												
(7) NOpportunity_IA	-0.02*	0.20*	0.23*	0.24*	0.59*	0.47*	1.00											
(8) FIEstimateRisk	0.20*	0.29*	0.36*	0.28*	0.14*	0.07*	0.14*	1.00										
(9) FIEstimateOpp	0.18*	0.26*	0.30*	0.26*	0.05*	0.04*	0.12*	0.49*	1.00									
(10) MVE	0.19*	0.21*	0.20*	0.23*	-0.02*	0.03*	0.06*	0.19*	0.20*	1.00								
(11) BidAsk	-0.27*	-0.22*	-0.20*	-0.23*	0.00	0.00	-0.03*	-0.09*	-0.09*	-0.20*	1.00							
(12) logSales	0.41*	0.40*	0.38*	0.41*	0.04*	0.04*	0.10*	0.26*	0.25*	0.46*	-0.44*	1.00						
(13) Cash	-0.14*	-0.15*	-0.12*	-0.15*	-0.04*	-0.01	-0.05*	-0.05*	-0.04*	-0.01	-0.01	-0.29*	1.00					
(14) ROA	0.05*	0.01	0.00	0.01	-0.03*	-0.02	-0.05*	-0.03*	-0.03*	0.17*	-0.13*	0.13*	0.08*	1.00				
(15) BTM	0.00	0.02*	0.03*	0.00	0.06*	0.01	0.02*	0.05*	0.02*	-0.20*	0.15*	0.06*	-0.16*	-0.36*	1.00			
(16) LEV	0.07*	0.10*	0.08*	0.10*	0.02*	0.02	0.05*	0.03*	0.02	0.04*	-0.04*	0.19*	-0.35*	-0.17*	0.01	1.00		
(17) IntangStock	-0.01	-0.05*	-0.04*	-0.03*	-0.03*	-0.03*	-0.04*	-0.03*	-0.02	0.04*	-0.04*	-0.12*	0.15*	0.04*	0.00	-0.37*	1.00	
(18) InstOwn	0.13*	0.10*	0.05*	0.12*	0.00	0.00	0.00	-0.01	0.00	0.12*	-0.24*	0.23*	-0.13*	0.12*	-0.16*	0.11*	0.00	1.00

** p<0.01*

Panel B: Spearman Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) CDP	1.00																	
(2) CR	0.67	1.00																
(3) FI	0.55	0.83	1.00															
(4) Opp	0.70	0.92	0.78	1.00														
(5) NTransRisk_IA	-0.11	0.11	0.09	0.01	1.00													
(6) NPhysRisk_IA	-0.15	0.04	0.05	-0.06	0.20	1.00												
(7) NOpportunity_IA	0.07	0.27	0.30	0.28	0.42	0.30	1.00											
(8) FIEstimateRisk	0.53	0.80	0.97	0.76	0.10	0.05	0.31	1.00										
(9) FIEstimateOpp	0.53	0.75	0.86	0.76	0.03	0.00	0.32	0.89	1.00									
(10) MVE	0.33	0.33	0.32	0.35	-0.03	-0.02	0.11	0.33	0.35	1.00								
(11) BidAsk	-0.30	-0.26	-0.24	-0.28	0.06	0.04	-0.07	-0.24	-0.26	-0.66	1.00							
(12) logSales	0.41	0.41	0.39	0.42	-0.01	-0.03	0.15	0.42	0.43	0.72	-0.55	1.00						
(13) Cash	-0.09	-0.11	-0.08	-0.11	-0.02	0.00	-0.03	-0.08	-0.08	-0.10	0.08	-0.21	1.00					
(14) ROA	0.04	0.00	-0.01	0.01	-0.03	-0.03	-0.03	-0.02	-0.02	0.24	-0.17	0.06	0.08	1.00				
(15) BTM	0.02	0.05	0.06	0.02	0.07	0.02	0.04	0.07	0.05	-0.37	0.28	0.09	-0.13	-0.49	1.00			
(16) LEV	0.09	0.11	0.09	0.12	0.01	0.00	0.04	0.09	0.09	0.11	-0.13	0.22	-0.39	-0.19	-0.00	1.00		
(17) IntangStock	0.02	-0.02	-0.02	-0.00	-0.01	-0.04	0.02	-0.02	-0.01	-0.03	-0.06	-0.06	0.18	0.12	-0.04	-0.37	1.00	
(18) InstOwn	0.11	0.08	0.04	0.10	-0.02	-0.02	0.01	0.03	0.04	0.29	-0.44	0.20	-0.15	0.13	-0.20	0.12	0.01	1.00

Spearman rho = 0.01

Table 5: Disclosure Determinants Regressions

Table 5 presents results from probit regressions examining the determinants of firms' decisions to respond to the CDP questionnaire and to provide TCFD-related climate risk, climate risk financial impacts, and climate-related opportunities disclosures. Columns (1) – (3) examine firms' decisions to respond to the CDP, columns (4)-(6) examine firms' decisions to provide climate risk disclosures, columns (7)-(9) examine firms' decision to disclose financial impact estimates of climate risk, and columns (10)-(12) examine the decision to disclose climate-related opportunities. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) CDP	(2) CDP	(3) CDP	(4) CR	(5) CR	(6) CR	(7) FI	(8) FI	(9) FI	(10) Opp	(11) Opp	(12) Opp
logSales	0.327***	0.338***	0.390***	0.348***	0.361***	0.400***	0.367***	0.385***	0.423***	0.354***	0.369***	0.411***
	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.016)	(0.015)	(0.015)	(0.017)	(0.014)	(0.015)	(0.016)
ForeignSale	0.303***	0.274***	0.275***	0.227***	0.157***	0.158***	0.227***	0.110*	0.115*	0.300***	0.222***	0.222***
	(0.051)	(0.054)	(0.059)	(0.052)	(0.054)	(0.059)	(0.055)	(0.058)	(0.064)	(0.052)	(0.054)	(0.059)
IndPropDisc	2.462***	2.609***	2.546***	2.045***	2.155***	1.645***	1.817***	1.874***	1.348***	2.011***	2.155***	1.663***
	(0.133)	(0.136)	(0.259)	(0.136)	(0.140)	(0.267)	(0.144)	(0.148)	(0.269)	(0.135)	(0.139)	(0.266)
Cash	-0.113	0.064	-0.411**	-0.660***	-0.478**	-0.750***	-0.488**	-0.329	-0.544**	-0.546***	-0.323	-0.643***
	(0.181)	(0.181)	(0.194)	(0.199)	(0.198)	(0.212)	(0.213)	(0.213)	(0.226)	(0.200)	(0.199)	(0.213)
ROA	-0.634**	-0.769**	-0.906***	-0.836**	-0.946***	-1.024***	-0.902**	-0.912**	-1.006***	-1.008***	-1.159***	-1.235***
	(0.306)	(0.307)	(0.319)	(0.335)	(0.333)	(0.343)	(0.356)	(0.354)	(0.365)	(0.328)	(0.326)	(0.338)
Loss	-0.106*	-0.126**	-0.138**	-0.036	-0.062	-0.061	-0.051	-0.064	-0.051	-0.038	-0.070	-0.059
	(0.058)	(0.058)	(0.059)	(0.061)	(0.061)	(0.061)	(0.064)	(0.065)	(0.066)	(0.060)	(0.060)	(0.061)
BTM	-0.076***	-0.063***	-0.052**	-0.070***	-0.053**	-0.026	-0.077***	-0.069***	-0.034	-0.092***	-0.072***	-0.047*
	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)	(0.025)	(0.025)	(0.026)	(0.027)	(0.024)	(0.024)	(0.025)
LEV	-0.045	0.045	0.048	0.043	0.109	0.139	0.083	0.136	0.132	0.086	0.171	0.189
	(0.133)	(0.133)	(0.138)	(0.139)	(0.139)	(0.144)	(0.148)	(0.149)	(0.153)	(0.139)	(0.139)	(0.144)
CapEx	0.752	0.751	1.412**	1.334**	1.315**	2.143***	1.198*	1.080	1.920**	0.638	0.625	1.537**
	(0.617)	(0.615)	(0.659)	(0.658)	(0.654)	(0.684)	(0.726)	(0.718)	(0.751)	(0.673)	(0.670)	(0.701)
PPE	0.011	-0.098	-0.150	0.159	0.049	-0.034	0.137	0.089	0.080	0.190	0.057	0.050
	(0.137)	(0.139)	(0.162)	(0.144)	(0.146)	(0.174)	(0.157)	(0.160)	(0.188)	(0.145)	(0.147)	(0.173)
IntangStock	0.626***	0.538***	0.548***	0.370*	0.281	0.165	0.432**	0.396*	0.214	0.598***	0.491**	0.410*
	(0.183)	(0.183)	(0.206)	(0.197)	(0.198)	(0.223)	(0.216)	(0.216)	(0.244)	(0.196)	(0.196)	(0.222)
IntangBS	0.353**	0.192	0.032	0.130	-0.049	-0.219	0.053	-0.042	-0.317*	0.339**	0.120	-0.028
	(0.139)	(0.146)	(0.159)	(0.144)	(0.153)	(0.169)	(0.155)	(0.164)	(0.182)	(0.144)	(0.152)	(0.167)
InstOwn	0.004***	0.004***	0.005***	0.004***	0.005***	0.005***	0.003***	0.004***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Block	-0.343***	-0.316***	-0.287***	-0.239***	-0.231***	-0.203***	-0.251***	-0.252***	-0.229***	-0.218***	-0.204***	-0.171**
	(0.070)	(0.071)	(0.073)	(0.069)	(0.069)	(0.070)	(0.070)	(0.071)	(0.071)	(0.070)	(0.071)	(0.072)
GDP	-0.011***	-0.015***	-0.017***	-0.016***	-0.018***	-0.021***	-0.020***	-0.020***	-0.022***	-0.015***	-0.018***	-0.021***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
F1RegEffect		0.093***	0.106***		0.047**	0.061***		0.013	0.023		0.065***	0.081***
		(0.019)	(0.020)		(0.021)	(0.022)		(0.022)	(0.023)		(0.021)	(0.022)
F2Cultural		-0.075***	-0.077***		-0.052**	-0.067**		0.027	0.005		-0.070***	-0.082***
		(0.025)	(0.026)		(0.026)	(0.027)		(0.027)	(0.029)		(0.026)	(0.027)
F3Freedom		0.077***	0.105***		0.116***	0.142***		0.147***	0.176***		0.135***	0.163***
		(0.023)	(0.024)		(0.025)	(0.026)		(0.027)	(0.028)		(0.025)	(0.027)
_cons	-3.261***	-3.211***	-3.412***	-3.535***	-3.565***	-3.726***	-3.517***	-3.756***	-3.842***	-3.663***	-3.688***	-3.993***
	(0.182)	(0.190)	(0.284)	(0.190)	(0.200)	(0.317)	(0.202)	(0.215)	(0.352)	(0.193)	(0.203)	(0.320)
Observations	17272	17272	17272	17272	17272	17272	17272	17272	17272	17272	17272	17272
Pseudo R^2	0.187	0.193	0.211	0.180	0.185	0.202	0.181	0.187	0.206	0.185	0.192	0.210
FF48 FE	NO	NO	YES	NO	NO	YES	NO	NO	YES	NO	NO	YES
Year FE	NO	NO	YES	NO	NO	YES	NO	NO	YES	NO	NO	YES

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

Table 6: Disclosure Determinants Regressions Including Governance and Environmental Variables

Table 6 presents results from our full Table 5 model probit regressions examining the determinants of firms' decisions to respond to the CDP questionnaire and to provide TCFD-related climate risk, climate risk financial impacts, and climate-related opportunities disclosures. Columns (1)-(4) show our full Table 5 model regressions for each of the *CDP, CR, FI,* and *Opp* variables including the governance-related variables *IndepDir, SustCommittee, UNSign,* and *SustReport*. Columns (5)-(8) additionally add each of the *EnvScore, logCO2e,* and *CCExposure* variables. In order to maximize the available sample size, the governance-related variables are set to zero if missing and we estimate a fitted model for each of *EnvScore, logCO2e,* and *CCExposure* variables as a function of *logSales, ROA, BTM, Cash, IntangStock, Industry FE, Country FE, Year FE* and we replace missing values of each of *EnvScore, logCO2e,* and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) CDP	(2) CR	(3) FI	(4) Opp	(5) CDP	(6) CR	(7) FI	(8) Opp
EnvScore					0.017***	0.017***	0.018***	0.018***
					(0.001)	(0.001)	(0.001)	(0.001)
logCO2e					0.005	0.042**	0.053**	0.038*
					(0.020)	(0.020)	(0.021)	(0.020)
CCExposure					14.104	7.249	4.851	16.313*
					(9.770)	(8.707)	(8.452)	(8.648)
IndepDir	-0.003***	-0.002**	-0.002**	-0.001*	-0.000	-0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
SustCommittee	0.404***	0.446***	0.499***	0.405***	0.238***	0.277***	0.329***	0.224***
	(0.046)	(0.046)	(0.051)	(0.046)	(0.047)	(0.048)	(0.054)	(0.048)
EMS	0.252***	0.199***	0.227***	0.222***	0.213***	0.149***	0.175***	0.170***
	(0.046)	(0.046)	(0.049)	(0.045)	(0.047)	(0.047)	(0.050)	(0.046)
UNSign	0.545***	0.411***	0.373***	0.488***	0.426***	0.296***	0.261***	0.369***
	(0.055)	(0.048)	(0.048)	(0.048)	(0.055)	(0.049)	(0.049)	(0.049)
SustReport	0.271***	0.238***	0.157***	0.233***	0.072	0.071	-0.006	0.048
	(0.050)	(0.051)	(0.056)	(0.050)	(0.052)	(0.054)	(0.061)	(0.053)
logSales	0.258***	0.267***	0.293***	0.273***	0.166***	0.166***	0.189***	0.167***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.018)	(0.018)	(0.019)	(0.018)
ForeignSale	0.063	-0.042	-0.078	0.016	0.043	-0.072	-0.107*	-0.013
	(0.060)	(0.060)	(0.064)	(0.060)	(0.061)	(0.060)	(0.065)	(0.060)
IndPropDisc	2.567***	1.593***	1.310***	1.626***	2.715***	1.696***	1.395***	1.728***
	(0.274)	(0.277)	(0.282)	(0.278)	(0.279)	(0.283)	(0.291)	(0.285)
Cash	-0.312	-0.650***	-0.434*	-0.530**	-0.114	-0.487**	-0.263	-0.362*
	(0.194)	(0.213)	(0.227)	(0.213)	(0.195)	(0.218)	(0.234)	(0.220)
ROA	-0.482	-0.577*	-0.564	-0.769**	-0.110	-0.174	-0.136	-0.352
	(0.318)	(0.341)	(0.366)	(0.334)	(0.323)	(0.347)	(0.378)	(0.339)

Loss	-0.177***	-0.080	-0.067	-0.077	-0.177***	-0.082	-0.067	-0.079
	(0.060)	(0.061)	(0.065)	(0.061)	(0.060)	(0.062)	(0.066)	(0.062)
BTM	-0.011	0.015	0.003	-0.004	0.001	0.024	0.013	0.006
	(0.025)	(0.025)	(0.027)	(0.025)	(0.025)	(0.025)	(0.027)	(0.025)
LEV	0.085	0.192	0.184	0.238*	0.064	0.164	0.158	0.217
	(0.139)	(0.145)	(0.155)	(0.144)	(0.139)	(0.146)	(0.158)	(0.146)
CapEx	1.473**	2.102***	1.796**	1.464**	1.586**	2.154***	1.791**	1.521**
	(0.656)	(0.679)	(0.753)	(0.705)	(0.664)	(0.679)	(0.757)	(0.714)
PPE	-0.192	-0.070	0.063	0.027	-0.247	-0.208	-0.102	-0.099
	(0.162)	(0.172)	(0.186)	(0.172)	(0.165)	(0.175)	(0.191)	(0.176)
IntangStock	0.645***	0.216	0.261	0.467**	0.545***	0.106	0.135	0.368
	(0.204)	(0.223)	(0.244)	(0.221)	(0.208)	(0.228)	(0.252)	(0.226)
IntangBS	-0.083	-0.326*	-0.414**	-0.133	-0.096	-0.358**	-0.458**	-0.151
	(0.158)	(0.168)	(0.181)	(0.165)	(0.159)	(0.171)	(0.186)	(0.168)
InstOwn	0.005***	0.005***	0.004***	0.005***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Block	-0.309***	-0.207***	-0.229***	-0.178**	-0.307***	-0.200***	-0.219***	-0.169**
	(0.075)	(0.071)	(0.072)	(0.073)	(0.077)	(0.073)	(0.074)	(0.076)
GDP	-0.015***	-0.018***	-0.019***	-0.018***	-0.014***	-0.018***	-0.018***	-0.017***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
F1RegEffect	0.107***	0.061***	0.024	0.081***	0.123***	0.078***	0.043*	0.098***
	(0.021)	(0.022)	(0.023)	(0.022)	(0.021)	(0.022)	(0.023)	(0.022)
F2Cultural	-0.129***	-0.103***	-0.029	-0.115***	-0.136***	-0.111***	-0.037	-0.123***
	(0.028)	(0.029)	(0.030)	(0.028)	(0.028)	(0.029)	(0.030)	(0.028)
F3Freedom	0.055**	0.088***	0.122***	0.106***	0.053**	0.092***	0.128***	0.110***
	(0.024)	(0.025)	(0.026)	(0.025)	(0.024)	(0.025)	(0.026)	(0.025)
_cons	-2.804***	-3.175***	-3.360***	-3.415***	-2.912***	-3.334***	-3.538***	-3.604***
	(0.302)	(0.335)	(0.368)	(0.336)	(0.316)	(0.339)	(0.372)	(0.339)
Observations	17272	17272	17272	17272	17272	17272	17272	17272
Pseudo R^2	0.263	0.247	0.250	0.258	0.290	0.276	0.280	0.290
FF48 FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 7: Valuation and Bid-Ask Spread Regressions CDP Disclosure

Table 7 presents results from the balance-sheet valuation model and bid-ask spread models on an indicator variable taking the value of one if a firm discloses to the CDP. Column (1)-(3) show valuation regressions with market value of equity measured at the end of the disclosure year as the dependent variable. Column (4)-(6) show bid-ask spread regressions with the median spread over the disclosure year as the dependent variable. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) MVE	(2) MVE	(3) MVE	(4) BidAsk	(5) BidAsk	(6) BidAsk
CDP	1262.546***	1176.325***	677.565	-0.122***	-0.095***	-0.093***
	(398.735)	(431.083)	(412.318)	(0.012)	(0.012)	(0.012)
Asset	0.578***	0.607***	0.607***			
	(0.092)	(0.088)	(0.088)			
Liab	-0.731***	-0.753***	-0.756***			
	(0.132)	(0.128)	(0.127)			
OpInc	8.986***	8.561***	8.475***			
	(0.654)	(0.626)	(0.626)			
F1RegEffect		-203.514	-192.619		0.019***	0.020***
		(152.772)	(153.001)		(0.005)	(0.005)
F2Cultural		-3184.577***	-3198.386***		-0.163***	-0.162***
		(271.876)	(276.633)		(0.009)	(0.009)
F3Freedom		-500.154**	-672.166***		0.007	0.010
		(208.527)	(208.898)		(0.006)	(0.006)
EnvScore			29.554**			-0.000
			(11.658)			(0.000)
logCO2e			-853.129***			0.027***
			(202.770)			(0.006)
CCExposure			-64549.945			-4.597*
			(119527.271)			(2.526)
logMVE				-0.121***	-0.131***	-0.131***
				(0.005)	(0.005)	(0.006)
logRetVar_t1				0.177***	0.139***	0.142***
				(0.013)	(0.016)	(0.016)
logShareTurn_t1				-0.345***	-0.369***	-0.376***
				(0.013)	(0.015)	(0.016)
BTM					0.030***	0.024**
					(0.011)	(0.012)
ROA					0.335***	0.383***
					(0.108)	(0.108)
Loss					0.133***	0.132***
					(0.026)	(0.025)
IntangStock					-0.264***	-0.195***
					(0.069)	(0.071)
InstOwn					-0.003***	-0.003***
					(0.000)	(0.000)
Block					-0.012	-0.009
					(0.020)	(0.020)
_cons	1003.872***	-2367.264***	568.366	1.238***	1.827***	1.710***
	(209.043)	(509.511)	(1083.460)	(0.049)	(0.136)	(0.138)
Observations	17272	17272	17272	17272	17272	17272
R-squared	0.660	0.696	0.697	0.313	0.406	0.408
FF48 FE	NO	YES	YES	NO	YES	YES
Year FE	NO	YES	YES	NO	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 8: Valuation Regressions TCFD Climate-related Risk and Opportunities

Table 8 shows Full Information Maximum Likelihood Heckman model valuation regressions for climate risk and opportunities disclosures. The first stage selection model is our full Table 5 column (3) determinants model for the probability of providing CDP disclosures. The dependent variable is market value of equity measured at the end of the disclosure year. In order to maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) MVE	(2) MVE	(3) MVE	(4) MVE	(5) MVE
CR	-818.476**				
	(405.364)				
NPhysRisk_IA		233.638			
		(203.235)			
NTransRisk_IA			-842.48***		
			(134.662)		
NRepTrans_IA				-1369.514***	
				(431.983)	
NLegalRegTrans_IA				-854.579***	
				(230.526)	
NMarketTrans_IA				-667.861**	
				(338.489)	
NTechTrans_IA				-549.75	
				(540.247)	
NOpportunity_IA					-152.057
					(132.705)
Asset	.541***	.542***	.548***	.549***	.543***
	(.025)	(.025)	(.025)	(.025)	(.026)
Liab	-.685***	-.685***	-.695***	-.698***	-.687***
	(.04)	(.04)	(.04)	(.04)	(.041)
OpInc	8.997***	8.995***	8.971***	8.969***	8.993***
	(.138)	(.138)	(.138)	(.138)	(.138)
EnvScore	39.164***	34.146***	36.652***	36.095***	36.255***
	(10.631)	(10.438)	(10.403)	(10.419)	(10.487)
logCO2e	-979.587***	-1007.56***	-918.988***	-923.468***	-990.256***
	(169.852)	(169.532)	(169.688)	(169.888)	(169.843)
CCExposure	-222593.66***	-223151.26***	-242682.57***	-239908.5***	-221558.55***
	(83986.777)	(83999.532)	(83894.033)	(83899.651)	(84011.087)
F1RegEffect	121.694	131.794	93.85	91.861	124.783
	(193.54)	(193.541)	(193.232)	(193.433)	(193.582)
F2Cultural	-3946.957***	-3947.086***	-3924.774***	-3921.134***	-3951.459***
	(210.874)	(210.92)	(210.525)	(210.81)	(210.92)
F3Freedom	-780.795***	-778.984***	-786.636***	-796.286***	-786.188***
	(199.417)	(199.665)	(198.994)	(199.139)	(199.43)
_cons	-852.929	-967.429	-1374.195	-1351.851	-1135.701
	(2826.411)	(2826.065)	(2820.442)	(2821.399)	(2826.812)
Mills Ratio	387.407	553.793	216.743	186.057	471.713
	(756.438)	(753.661)	(753.516)	(753.871)	(754.943)
Observations	17272	17272	17272	17272	17272
Chi^2	20817.352	20806.173	20928.15	20936.781	20807.548
p	0	0	0	0	0
FF48 FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

Table 9: Bid-Ask Spread Regressions TCFD Climate-related Risk and Opportunities

Table 9 shows Full Information Maximum Likelihood Heckman model bid-ask spread regressions for climate risk disclosures. The first stage selection model is our full Table 5 column (3) determinants model for the probability of providing CDP disclosures. The dependent variable is bid-ask spreads measured as the median spread over the disclosure year. In order to maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) BidAsk	(2) BidAsk	(3) BidAsk	(4) BidAsk	(5) BidAsk
CR	.0014				
	(.0066)				
NPhysRisk_IA		.0054			
		(.0033)			
NTransRisk_IA			-.0014		
			(.0022)		
NRepTrans_IA				.0106	
				(.0071)	
NLegalRegTrans_IA				-.0035	
				(.0038)	
NMarketTrans_IA				-.0068	
				(.0056)	
NTechTrans_IA				.0006	
				(.0089)	
NOpportunity_IA					-.0034
					(.0022)
logMVE	-.0552***	-.0551***	-.0552***	-.0552***	-.0552***
	(.0033)	(.0033)	(.0033)	(.0033)	(.0033)
logRetVar_t1	.0919***	.0923***	.0919***	.0917***	.0917***
	(.0098)	(.0098)	(.0098)	(.0098)	(.0098)
logShareTurn_t1	-.2292***	-.2293***	-.2294***	-.2295***	-.2298***
	(.0086)	(.0086)	(.0086)	(.0086)	(.0086)
BTM	.0325***	.0326***	.0327***	.0324***	.0326***
	(.0051)	(.0051)	(.0051)	(.0051)	(.0051)
ROA	.1057	.1055	.1061	.1049	.1023
	(.0694)	(.0694)	(.0693)	(.0693)	(.0693)
Loss	.0035	.0031	.0035	.0034	.0036
	(.0147)	(.0147)	(.0147)	(.0147)	(.0147)
IntangStock	-.0429	-.0413	-.0437	-.0434	-.0441
	(.0348)	(.0348)	(.0348)	(.0348)	(.0348)
InstOwn	-.0029***	-.0028***	-.0028***	-.0029***	-.0028***
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Block	-.0009	-.0008	-.0009	-.0008	-.001
	(.0127)	(.0127)	(.0127)	(.0127)	(.0127)
F1RegEffect	.0232***	.0232***	.0231***	.0232***	.023***
	(.0033)	(.0033)	(.0033)	(.0033)	(.0033)
F2Cultural	-.0753***	-.0752***	-.0753***	-.0755***	-.0754***
	(.0043)	(.0043)	(.0043)	(.0043)	(.0043)
F3Freedom	.008**	.0083**	.008**	.0081**	.008**
	(.0037)	(.0037)	(.0037)	(.0037)	(.0037)
EnvScore	-.0004**	-.0004**	-.0004**	-.0004**	-.0004**
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
logCO2e	.0143***	.0142***	.0144***	.0144***	.0145***
	(.0029)	(.0029)	(.0029)	(.0029)	(.0029)
CCExposure	1.1688	1.1815	1.1334	1.1421	1.1944
	(1.3955)	(1.3954)	(1.3964)	(1.3966)	(1.3951)
_cons	.8181***	.8179***	.8183***	.8172***	.8174***

	(.0627)	(.0627)	(.0626)	(.0627)	(.0626)
Mills Ratio	.1776***	.178***	.1767***	.1772***	.176***
	(.0151)	(.0151)	(.0151)	(.0151)	(.0151)
Observations	17272	17272	17272	17272	17272
Chi^2	2830.6374	2833.2614	2832.4399	2836.7154	2836.1544
p	0	0	0	0	0
FF48 FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 10: Valuation and Bid-Ask Regressions on Financial Impact Estimates

Table 10 shows Full Information Maximum Likelihood Heckman valuation and bid-ask spread regressions on the financial impact estimates of climate-related risks and opportunities. The first stage selection model is our full Table 5 column (3) determinants model for the probability of providing CDP disclosures. Columns (1)-(2) show valuation regressions with market value of equity measured at the end of the disclosure year as the dependent variable and the unscaled financial impact estimates (*FIEstimateRisk* and *FIEstimateOpp*) as the test variable of interest. Columns (3)-(4) show bid-ask spread regressions with the median spread over the disclosure year as the dependent variable and the scaled financial impact estimates (*FIEstimateRisk_S* and *FIEstimateOpp_S*) as the test variable of interest. To maximize the available sample size, we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) MVE	(2) MVE	(3) BidAsk	(4) BidAsk
FIEstimateRisk	-.2995* (.1748)			
FIEstimateOpp		.0688 (.0711)		
FIEstimateRisk_S			.0068 (.0291)	
FIEstimateOpp_S				-.0113 (.0127)
Asset	.5449*** (.0256)	.5389*** (.0256)		
Liab	-.6866*** (.0405)	-.6834*** (.0405)		
OpInc	8.9915*** (.1382)	9.0009*** (.1382)		
logMVE			-.0545*** (.0033)	-.0543*** (.0033)
logRetVar_t1			.0921*** (.0098)	.0921*** (.0098)
logShareTurn_t1			-.2298*** (.0086)	-.2298*** (.0086)
BTM			.033*** (.0051)	.033*** (.0051)
ROA			.1034 (.0696)	.1004 (.0696)
Loss			.0027 (.0147)	.0025 (.0148)
IntangStock			-.0419 (.0349)	-.0416 (.0349)
InstOwn			-.0028*** (.0002)	-.0028*** (.0002)
Block			-.0012 (.0127)	-.0015 (.0127)
_cons	-1034.5025 (2825.1778)	-999.8311 (2825.7492)	.81*** (.0631)	.8067*** (.0631)
Mills Ratio	448.5265 (754.6993)	557.4902 (753.9542)	.1803*** (.0152)	.1811*** (.0153)
Observations	17272	17272	17266	17266
Chi^2	20812.952	20804.902	2811.6394	2811.3426
p	0	0	0	0
Country Factors	YES	YES	YES	YES
Env Controls	YES	YES	YES	YES
FF48 FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table OA.1: Determinants of Disclosing Privately to the CDP

Table OA.1 presents results from probit regressions examining the determinants of firms' decisions to respond privately to the CDP questionnaire, conditional on reporting to the CDP. Columns (1)-(3) show our determinants models for *CDP_private*. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) CDP_private	(2) CDP_private	(3) CDP_private
logSales	-0.202***	-0.213***	-0.231***
	(0.016)	(0.016)	(0.017)
ForeignSale	-0.138**	-0.059	-0.072
	(0.063)	(0.066)	(0.071)
IndPropDisc	-0.464***	-0.546***	0.402
	(0.170)	(0.173)	(0.412)
Cash	0.350	0.211	0.390
	(0.254)	(0.258)	(0.265)
ROA	0.346	0.386	0.273
	(0.425)	(0.424)	(0.431)
Loss	-0.061	-0.050	-0.075
	(0.077)	(0.077)	(0.079)
BTM	0.081***	0.069**	0.030
	(0.028)	(0.029)	(0.031)
LEV	0.026	-0.034	-0.083
	(0.165)	(0.166)	(0.175)
CapEx	-0.550	-0.522	-0.997
	(0.818)	(0.811)	(0.867)
PPE	-0.445**	-0.379**	-0.349*
	(0.179)	(0.184)	(0.209)
IntangStock	-0.668***	-0.632**	-0.380
	(0.243)	(0.247)	(0.278)
IntangBS	-0.415**	-0.293	-0.049
	(0.176)	(0.186)	(0.196)
InstOwn	-0.002*	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)
Block	0.013	0.016	0.001
	(0.084)	(0.084)	(0.085)
GDP	0.011***	0.011***	0.012***
	(0.002)	(0.003)	(0.003)
F1RegEffect		-0.029	-0.034
		(0.025)	(0.025)
F2Cultural		0.015	0.033
		(0.032)	(0.033)
F3Freedom		-0.107***	-0.129***
		(0.027)	(0.028)
_cons	0.956***	1.074***	1.331***
	(0.226)	(0.239)	(0.410)
Observations	9857	9857	9834
Pseudo R^2	0.055	0.059	0.085
FF48 FE	NO	NO	YES
Year FE	NO	NO	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table OA.2: Fitted values models

Table OA.2 presents fitted models for each of the *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE*. We use the fitted values derived from these models to replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* in the determinants, market value, and bid-ask spread regressions reported in the tables in the paper and in the remainder of this online appendix.

	(1) CCExposure	(2) EnvScore	(3) logCO2e
logSales	0.0001***	9.5580***	0.0262***
	(0.0000)	(0.1322)	(0.0096)
Cash	0.0005*	-14.1675***	-1.3856***
	(0.0003)	(1.7995)	(0.1368)
ROA	-0.0018***	-29.4346***	-2.2008***
	(0.0004)	(2.9670)	(0.2197)
BTM	-0.0000	-1.4191***	0.1737***
	(0.0000)	(0.2667)	(0.0185)
IntangStock	-0.0018***	13.3084***	-2.6187***
	(0.0003)	(1.8891)	(0.1372)
_cons	0.0005	-26.5362***	5.1110***
	(0.0004)	(2.5420)	(0.1827)
Observations	9466	13532	9887
R-squared	0.4985	0.4050	0.6009
FF48 FE	YES	YES	YES
Year FE	YES	YES	YES
Country FE	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table OA.3: Plain Vanilla Determinants Models

Table OA.3 presents our Table 6 determinants regressions with *IntangStock* excluded and all other financial variables left unadjusted for the capitalization and amortization of internally generated intangibles. In order to maximize the available sample size, the governance-related variables are set to zero if missing and we estimate a fitted model for each of *EnvScore*, *logCO2e*, and *CCExposure* variables as a function of *logSales*, *ROA*, *BTM*, *Cash*, *IntangStock*, *Industry FE*, *Country FE*, *Year FE* and we replace missing values of each of *EnvScore*, *logCO2e*, and *CCExposure* with their fitted values. Standard errors are clustered at the firm level, institutional ownership is truncated at 100% and all other continuous variables are winsorized at the 1st and 99th percentile by fiscal year.

	(1) CDP	(2) CR	(3) FI	(4) Opp	(5) CDP	(6) CR	(7) FI	(8) Opp
EnvScore					0.017***	0.018***	0.018***	0.018***
					(0.001)	(0.001)	(0.001)	(0.001)
logCO2e					0.001	0.043**	0.057***	0.041**
					(0.020)	(0.020)	(0.021)	(0.020)
CCExposure					12.494	6.842	5.043	16.141*
					(9.723)	(8.695)	(8.438)	(8.624)
IndepDir	-0.003***	-0.002**	-0.002**	-0.002*	-0.000	-0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
SustCommittee	0.399***	0.446***	0.498***	0.404***	0.232***	0.275***	0.328***	0.222***
	(0.046)	(0.046)	(0.051)	(0.046)	(0.047)	(0.048)	(0.054)	(0.048)
EMS	0.256***	0.200***	0.230***	0.226***	0.215***	0.147***	0.175***	0.171***
	(0.046)	(0.046)	(0.049)	(0.045)	(0.047)	(0.047)	(0.050)	(0.046)
UNSign	0.550***	0.414***	0.374***	0.492***	0.428***	0.297***	0.261***	0.371***
	(0.055)	(0.048)	(0.048)	(0.048)	(0.055)	(0.049)	(0.049)	(0.049)
SustReport	0.269***	0.237***	0.157***	0.234***	0.068	0.070	-0.005	0.048
	(0.050)	(0.051)	(0.056)	(0.050)	(0.052)	(0.054)	(0.061)	(0.053)
logSales	0.254***	0.263***	0.289***	0.267***	0.163***	0.162***	0.187***	0.162***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.018)	(0.018)	(0.019)	(0.018)
ForeignSale	0.052	-0.047	-0.086	0.004	0.037	-0.074	-0.114*	-0.023
	(0.061)	(0.060)	(0.064)	(0.060)	(0.061)	(0.060)	(0.065)	(0.060)
IndPropDisc	2.512***	1.565***	1.283***	1.591***	2.675***	1.678***	1.376***	1.700***
	(0.274)	(0.278)	(0.283)	(0.279)	(0.280)	(0.284)	(0.292)	(0.286)
Cash_plain	-0.262	-0.555***	-0.430**	-0.465***	-0.086	-0.409**	-0.279	-0.311*
	(0.162)	(0.180)	(0.193)	(0.180)	(0.163)	(0.184)	(0.199)	(0.184)
ROA_plain	0.033	-0.139	-0.126	-0.276	0.185	0.036	0.069	-0.101
	(0.273)	(0.300)	(0.316)	(0.292)	(0.278)	(0.306)	(0.327)	(0.298)
Loss_plain	-0.174***	-0.120*	-0.081	-0.134**	-0.176***	-0.131**	-0.092	-0.143**
	(0.062)	(0.064)	(0.068)	(0.064)	(0.062)	(0.065)	(0.068)	(0.064)

BTM_plain	-0.010	0.038	0.032	0.021	-0.003	0.038	0.032	0.022
	(0.035)	(0.036)	(0.039)	(0.036)	(0.036)	(0.036)	(0.039)	(0.037)
LEV_plain	0.085	0.193	0.169	0.237*	0.056	0.158	0.136	0.205
	(0.119)	(0.126)	(0.135)	(0.124)	(0.120)	(0.127)	(0.138)	(0.126)
CapEx_plain	1.264**	1.724***	1.483**	1.187*	1.400**	1.805***	1.509**	1.264**
	(0.583)	(0.611)	(0.680)	(0.631)	(0.590)	(0.613)	(0.685)	(0.641)
PPE_plain	-0.207	-0.089	0.024	-0.007	-0.259*	-0.236	-0.153	-0.144
	(0.146)	(0.155)	(0.168)	(0.155)	(0.150)	(0.159)	(0.173)	(0.160)
RD	1.501***	0.768	1.500**	1.838***	0.908	0.203	0.992	1.310**
	(0.563)	(0.661)	(0.719)	(0.606)	(0.577)	(0.671)	(0.729)	(0.608)
IntangBS_plain	-0.078	-0.301**	-0.364**	-0.111	-0.097	-0.344**	-0.418**	-0.140
	(0.139)	(0.148)	(0.159)	(0.145)	(0.140)	(0.150)	(0.163)	(0.147)
InstOwn	0.005***	0.005***	0.004***	0.005***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Block	-0.315***	-0.212***	-0.229***	-0.178**	-0.314***	-0.204***	-0.218***	-0.170**
	(0.075)	(0.071)	(0.072)	(0.074)	(0.077)	(0.073)	(0.074)	(0.076)
GDP	-0.015***	-0.018***	-0.019***	-0.018***	-0.014***	-0.018***	-0.018***	-0.017***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
F1RegEffect	0.109***	0.062***	0.024	0.082***	0.124***	0.078***	0.042*	0.099***
	(0.021)	(0.022)	(0.023)	(0.022)	(0.021)	(0.022)	(0.023)	(0.022)
F2Cultural	-0.132***	-0.106***	-0.031	-0.117***	-0.139***	-0.115***	-0.038	-0.126***
	(0.028)	(0.029)	(0.030)	(0.028)	(0.028)	(0.029)	(0.030)	(0.028)
F3Freedom	0.059**	0.090***	0.125***	0.109***	0.055**	0.095***	0.131***	0.113***
	(0.024)	(0.025)	(0.026)	(0.025)	(0.024)	(0.025)	(0.026)	(0.025)
_cons	-2.707***	-3.138***	-3.330***	-3.352***	-2.804***	-3.298***	-3.516***	-3.543***
	(0.298)	(0.330)	(0.364)	(0.330)	(0.310)	(0.332)	(0.366)	(0.332)
Observations	17272	17272	17272	17272	17272	17272	17272	17272
Pseudo R^2	0.262	0.247	0.250	0.258	0.289	0.276	0.280	0.290
FF48 FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*