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Climate Risk Disclosure and Institutional Investors

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Abstract

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Keywords: Climate risk, disclosure, institutional investors

JEL Classifications: G11, G3, Q54

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Institutional Investors' Views and Preferences on Climate Risk Disclosure

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1. Introduction

Financial market efficiency is generally considered to rely on timely and accurate information regarding firms' risk exposures. An increasingly important and pertinent risk exposure relates to climate change, which can originate from natural disasters, government regulation to combat a rise in temperature, or climate-related innovations that disrupt existing business models (Litterman 2016, Krueger, Sautner, and Starks 2020). Consequently, high-quality information on firms' climate risk exposures would appear to be a necessary component of informed investment decisions and of correct market pricing of the risks and opportunities related to climate change. Furthermore, with climate change being increasingly considered as a danger to the financial system (Carney 2015), sound disclosure on climate risks would also seem essential for regulatory efforts to protect financial stability (e.g., Goldstein and Yang 2017).

Moreover, regulators and investors have argued that current climate risk disclosure is insufficient. For example, Mark Carney, Governor of the Bank of England, called for more to be done *"to develop consistent, comparable, reliable and clear disclosure around the carbon intensity of different assets"* (Carney 2015). Four years later he stated that companies needed to *"increase the quantity and quality of their [climate-related] disclosures"* (Carney, 2019). Yngve Slyngstad, CEO of Norges Bank Investment Management, has also discussed the difficulty of obtaining such data: *"The only surprise […] is how hard it is to get the data […] I think it will take years to get good data from the majority of companies we are invested in."*[1]

To address perceived shortcomings in current disclosures, some regulators, governments, and NGOs have sought to improve firm-level reporting on climate risks. For instance, in 2015, the Financial Stability Board initiated the Task Force on Climate-related Financial Disclosures (TCFD), with the objective of developing voluntary climate-related financial risk disclosures. In a similar spirit, on behalf of investors representing over $100 trillion in assets under management, the CDP collects climate-related information through a firm questionnaire.[2] In addition to these largely voluntary initiatives, some countries have

[1] See "Norway wealth fund builds tool to analyze climate risk to portfolio," *Reuters Market News*, October 31, 2018.
[2] See https://www.cdp.net/en

begun to mandate climate-related disclosures. For example, since 2013, the U.K. requires exchange-traded companies to disclose their carbon emissions (Krueger 2015; Jouvenot and Krueger 2019), and since 2016, France requires institutional investors to report the carbon footprints of their investment portfolios.[3]

Despite these calls and regulatory actions to increase climate-related disclosures, the fact that many companies are still not providing the disclosures voluntarily suggests that there exist counterbalancing considerations. That is, reporting on financial or nonfinancial information can have costs as well as benefits. As pointed out in reviews by Goldstein and Yang (2017), with respect to financial information, and Christensen, Hail, and Leuz (2019), with respect to nonfinancial information, although disclosure may increase stock liquidity, reduce a firm's cost of capital, and make the pricing of risks more efficient, the disclosures may also impose unwarranted costs on a firm. For example, in the climate finance context, disclosure on carbon emissions could reveal proprietary information about a firm's future strategy. Bond and Goldstein (2018) show theoretically that if firm managers rely on market prices to learn, there may exist a cost to divulging too much information that can affect the prices.[4] Given the uncertainty surrounding climate change and expected governmental responses, firm managers may rely more than in other circumstances on learning from market prices. Consequently, while the climate-risk disclosure initiatives suggest that some regulators, governments, NGOs, and investors believe that climate-related information is necessary for investment decision-making, little systematic evidence exists regarding the extent to which firms and their investors actually attribute value to the firms' climate risk disclosures. This lack of evidence may be due in part to the fact that such attribution is both theoretically ambiguous and not observable through the typical archival data methods.

To overcome these issues, we directly survey institutional investors about their views and preferences with respect to climate-related disclosures and support and extend our

[3] Recently, the *Climate Risk Disclosure Act of 2019* has been introduced in the U.S. Senate and the U.S. House of Representatives, with the objective to introduce mandatory climate disclosure. If accepted, the bill would require firms to disclose greenhouse-gas emissions, the cumulative amount of fossil-fuel assets they own, and how climate change affects valuations in different climate scenarios.

[4] The authors' setting is with governments as the decision maker, but the authors point out that their results would also apply to firm management and boards of directors.

survey evidence with hypothesis tests of firms' carbon disclosures and their institutional investors' holdings.[5] Surveys are most valuable in addressing questions such as ours that are theoretically ambiguous and difficult or impossible to research through archival methods. Consequently, surveying the investors allows us to gain meaningful insights into whether and how investors value climate risk disclosure. Additionally, because we are able to link the survey responses to data on investor characteristics, which we also collect by means of the survey, we can conduct a more comprehensive examination of how institutional investors value the disclosures, their rationales and their actions.

Our respondent group consists of important decision-makers at some of the world's largest investors. About one-third of the respondents works at the executive level in their institutions, 11% of all respondents work for institutions with more than $100bn in assets under management, and 57% for institutions with more than $20bn in assets under management. We find that these respondents share a strong belief that climate disclosure is important. In fact, 51% believe climate risk reporting to be as important as traditional financial reporting, and almost one-third considers it to be more important. Only 22% of respondents regard climate reporting as less (or much less) important compared to financial reporting. Climate disclosure is perceived as more important among those investors who expect larger future temperature increases, those investors who believe more strongly that climate risks matter, and by those investors that worry most strongly about the financial consequences of the risks for their portfolios.[6] In addition, we find that investor characteristics are important, including that home country social norms play a role, consistent with conceptual (e.g., Williamson 2000) and empirical evidence (e.g., Dyck et al. 2019).

Climate change can negatively affect portfolio firms through three channels. Physical climate risks arise because of adverse effects of changes in the physical climate (e.g., sea level rises, natural disasters). Technological climate risks originate from climate-related

[5] Surveys are increasingly used in the finance literature, enabling better understandings of such topics as corporate financing (Graham and Harvey 2001), capital allocation (Graham, Harvey, and Puri 2015), investor activism (McCahery, Sautner, and Starks 2016), investor relations (Karolyi, Kim, and Liao 2020), climate risks (Krueger, Sautner, and Starks 2020), and ESG investing (Amel-Zadeh and Serafeim 2018).

[6] The latter result is consistent with the observation that many of those investors that push strongly for more climate disclosure are universal owners, that is, investors whose broad global equity ownership makes it difficult to avoid the consequences of climate change.

innovations that disrupt traditional producers (e.g., electric car manufacturers could displace traditional manufacturers), and regulatory risks result from costs associated with changes in policies or regulations to combat climate change (e.g., carbon taxes, cap and trade markets). With regard to the relative importance of these various types of climate risk for views on the importance of climate disclosure, our survey reveals that concerns about physical climate risks matter the most, while regulatory risks matter the least. An implication of this finding is that disclosure should be more valuable for evaluating less visible risks. For example, physical risks are potentially more difficult to observe because they are generally firm and location specific, thus requiring precise information about a firm's exposure to evaluate them correctly. Regulatory risks, on the other hand, tend to be firm independent and regulator dependent, and information on such risks would then be easier to obtain from sources outside of the firm.

The vast majority of our respondents believe that current quantitative and qualitative disclosures on climate risks are uninformative and imprecise. Many investors, especially those that worry more about the financial effects of climate risks, share the view that climate risk reporting should be mandatory and standardized, as is currently the case with financial reporting. These results combined with the views on the importance of climate-related disclosure suggest that the investors think that the benefits of this disclosure outweigh the costs, which is in line with the overall theoretical predictions discussed in Goldstein and Yang (2017) and Christensen, Hail, and Leuz (2019).

We also find that the investors generally believe that the lack of sufficient disclosure could be improved if investors actively engage firms by demanding them to provide more information about their climate risks. This widespread view echoes many investor initiatives, such as those at Exxon Mobil, Occidental Petroleum, and Royal Dutch Shell, in which groups of institutions have submitted shareholder proposals calling for these firms to share more information on their climate policies, including in some cases asking for the setting and publishing of carbon emission targets. Moreover, in some cases, when the subsequent

disclosure in response to these proposals has still been deemed inadequate, investors called for voting against the entire board.[7]

The investors also indicated they engage (or plan to engage) their portfolio firms regarding reporting that follows the recommendations of the TCFD, which suggests that the respondents believe that the current developments on standardization in climate disclosure are beneficial.[8] Further, our respondents indicate support for institutional investors themselves to provide more disclosure to their own clients, shareholders or participants in line with the recent French approach requiring institutional investors to report on the carbon footprints of their portfolios (60% either already disclose or plan to disclose their portfolios' footprints). This result indicates support for ongoing European Union policy efforts to broaden the French approach to other member states.

Next, we build on recent theoretical work that predicts a link between climate mispricing and disclosure (Daniel, Litterman, and Wagner 2018). Such a link would be quite difficult to establish using archival data, but our survey allows us to determine whether such a link could exist. We find that investors' opinions on the availability and quality of current climate reporting are strongly related to the perceived underpricing of climate risks in equity markets (i.e., climate-related overvaluation of firms). Notably, respondents who believe that current reporting is lacking also judge there to be more mispricing in current equity valuations. An important consequence of this finding is that better disclosure may contribute to the more efficient pricing of climate risks. This implication is consistent with both academic theory (e.g., Goldstein and Yang 2017) and practitioners' views (e.g., Michael R. Bloomberg, Chair of the TCFD, stated that "*increasing transparency makes markets more efficient, and economies more stable and resilient.*")[9]

To further support and extend our survey results with archival data, we employ firms' carbon disclosure data combined with institutional holdings data to test several hypotheses

[7] See "Exxon Shareholders Pressure Company on Climate Risks," *The Wall Street Journal*, May 31, 2017; "Occidental Shareholders Vote for Climate Proposal," *The Wall Street Journ*al, May 31, 2017; and "Exxon Directors Face Shareholder Revolt Over Climate Change" *Bloomberg*, May 4, 2019.

[8] These recommendations include disclosing climate-related risks and opportunities and their impact on firms' businesses; how firms' governance structures deal with these risks and opportunities; how firms identify, assess, and manage climate risks; and which metrics and targets firms use to assess and manage carbon emissions.

[9] See https://www.fsb-tcfd.org/.

that arise from previous research as well as the survey responses. The theoretical literature discussed above suggests that voluntary disclosure can also have unwarranted costs, but our survey indicates that institutional investors as a group value such information. Thus, we examine which firms choose to voluntarily disclose carbon emissions and predict that the propensity to disclose should be greater among firms with higher institutional ownership. Using an international sample of institutional investors and firms, we find a strong positive association between institutional ownership and voluntary climate disclosure, a result that is both economically and statistically significant given that a one-standard deviation expansion in institutional ownership in a firm increases the probability that the firm discloses emissions to the CDP by 14% (about 83% relative to the unconditional probability).

The other hypotheses we test in the firm disclosure and investor holdings data arise from theory and our survey results regarding the influence of social norms. Examining firms' voluntary carbon disclosures, we find that the positive relation between disclosure and institutional ownership is driven by institutions from countries with high social norms. We also find that higher ownership by institutions from high social norm countries increases the propensity that firms provide higher quality information by asking third parties to audit and verify the emissions data they disclose. These findings on the relationship between firms' decisions to voluntarily disclose their carbon emissions and to verify those emissions originate from both domestic and foreign institutions of high social norm countries, with foreign owners contributing most strongly to the results. Overall, the evidence from the archival data is broadly consistent with our survey responses that institutional investors value climate risk disclosure, and it helps elucidate previous theories on disclosure.[10]

Our paper contributes several novel findings to the literature on disclosure (e.g., Bond and Goldstein 2018; Jayaraman and Wu 2019, 2020) and more specifically to the literature on nonfinancial (or sustainability) reporting, of which climate risks are currently the most important component.[11] Matsumura, Prakash, and Vera-Muñoz (2014) conclude that markets

[10] We do not aim to establish a causal effect of institutional ownership on climate disclosure, but rather try to document some basic relations consistent with the survey responses and theory. For example, the positive correlation between institutional ownership and carbon disclosure could also result from a selection effect, whereby some firms voluntarily disclose carbon-related information to attract institutional shareholders.

[11] See Leuz and Wysocki (2016), Goldstein and Yang (2017), and Christensen, Hail, and Leuz (2019) for reviews.

discount firms that do not disclose emissions through the CDP, although Griffin, Lont, and Sun (2017) provide evidence suggesting that the differences may not arise from CDP disclosure. The latter authors also show that disclosing emissions through 8-Ks leads to higher volatility around the disclosures. Ilhan, Sautner, and Vilkov (2020) find that investors use information about carbon risks to quantify the impact of future climate regulation, by documenting that firms with larger emissions exhibit higher tail and variance risk. Matsumura, Prakash, and Vera-Muñoz (2018) analyze voluntary 10-K climate risk disclosures and find that disclosers have lower costs of equity.

Solomon et al. (2011) interview institutional investors who reveal that they use private channels of discourse with portfolio firms to compensate for the inadequacies of public climate reporting. Ramadorai and Zeni (2020) use data disclosed by firms to the CDP to infer their beliefs about climate regulation and their plans for future carbon emission abatement. We contribute by providing evidence on investor beliefs through a survey instrument. Further, our investor holdings analysis corresponds to the results of Flammer, Toffel, and Viswanathan (2019) who find that activism by institutional investors, especially the long-term ones, increases the voluntary disclosure of climate risks.

Krueger (2015) examines the valuation effects of the introduction of mandatory greenhouse-gas (GHG) disclosures in the U.K., and shows beneficial valuation effects resulting from the regulation. Examining the real effects of mandatory GHG reporting in the U.K., Jouvenot and Krueger (2019) document strong reductions in carbon emissions for U.K. firms relative to control firms from other jurisdictions. Focusing on the oil and gas industry, Eccles and Krzus (2018) examine the extent to which firms disclose information in line with the TCFD recommendations. Our primary contribution to this literature is providing and testing hypotheses regarding institutional investors' views and actions on climate-related disclosures using both a survey instrument and institutional holdings data.

2. Methodology and Survey Design

2.1 Survey Development and Delivery

The survey we employed was developed through an iterative process as suggested by Krosnick and Presser (2010). Thus we employed the feedback from academics and practitioners throughout the process with multiple versions of the survey presented for their feedback. We then had the survey reviewed by professional survey designer.[12] Employing both an online and a paper version of the survey, we distributed the survey through four delivery channels, yielding a total of 439 responses. First, we personally distributed the paper version at four institutional investor conferences: The Sustainable Investment Conference in Frankfurt on November 9, 2017; the ICGN Paris Event on December 6-7, 2017; the Asset Management with Climate Risk Conference at Cass Business School in London on January 23, 2018; and the ICPM Conference in Toronto on June 10-12, 2018. We obtained a total of 72 responses from these four conferences.

Second, we distributed the online version to 1,018 individuals in senior functions at institutional investors.[13] We identified these individuals using the help of a survey service provider that manages a global panel of more than 5m professionals. The panel contains detailed data on these individuals' job titles, employers, and their age to identify relevant subsamples. The service provider had several mechanisms in place to ensure the authenticity of the individuals. In March 2018, the provider emailed invitations to participate in the survey and we obtained 410 initial responses to these invitations. We then excluded 90 participants that took less than five minutes to complete the survey, and participants for which basic checks yielded logical inconsistencies in the responses (Meade and Craig 2012). This process left us with 320 responses of good quality. These respondents spent 15 minutes, on average, to complete the survey.

Third, in April 2018, we emailed invitations to participate in the survey to a list of institutional investors that cooperate with a major asset owner through CERES and IIGCC on

[12] The survey instrument is provided in Internet Appendix A. The original survey also contained questions on climate risk management and shareholder engagement, which are covered in Krueger, Sautner, and Starks (2020). More details of the iterative process that was used for developing the survey are provided in Krueger, Sautner, and Starks (2020).

[13] The online version was programmed so that response choices had random orderings.

climate risk topics. We obtained 28 responses through this channel. Fourth, we sent invitations to participate in the online survey to personal contacts at different institutional investors, yielding 19 additional responses.

We are confident that in the vast majority of cases we have only one observation per institution. The reason is that, for 87% of the observations, key identifying characteristics do not coincide.[14] In the remaining cases we cannot exclude the possibility that respondents work for the same institution. However, the responses are sufficiently different among these respondents to discount that possibility with some degree of assurance.

2.2 Respondent Characteristics

Table 1 provides an overview of the characteristics for our respondent groups. The largest numbers of respondents are fund or portfolio managers (21%), followed by executive or managing directors (18%). About one-third hold positions at the executive level in their institutions, as CIO (11%), CEO (10%), or in related functions (10%). Most respondents work for asset managers (23%) and banks (22%), followed by pension funds (17%), insurance companies (15%), and mutual funds (8%). We also have a wide variation in the institutions' size as 11% of the respondents work for institutions with assets of more than $100bn, 16% with assets between $50bn and $100bn, 23% with assets between $20bn and $50bn, 32% with assets between $1bn and $20bn, and 19% with assets less than $1bn.

Only 5% of respondents' institutions typically hold investments for less than six months, 38% have medium holding periods (six months to two years), 38% have long holding periods (two years to five years), and the remaining 18% typically hold investments for more than five years. Our respondent institutions are headquartered around the world: 32% are located in the U.S., 17% in the U.K. and Ireland, 12% in Canada, and 11% in Germany, among other countries. At the average institution, the portfolio share that incorporates ESG is 41%, invested in equities is 47%, invested in fixed income is 43%, and passively invested is 38%.

[14] These characteristics are location, assets under management, institutional investor type, investor horizon, ESG share (+/–10% variation in the variable), equity share (+/–10%), and passive share (+/–10%).

2.3 Response Bias

A question that naturally arises is the extent to which the characteristics of our respondents as well as their responses are representative of the institutional investor population. We assess this question through an evaluation of nonresponse bias by comparing key characteristics of the responding investors to those of the institutional investor population at large. To do this, we use data from the FactSet population of institutional investors and compare characteristics of these investors to our sampled population.[15] The comparison, reported in Internet Appendix Figure 1, shows that pension funds and banks are somewhat overrepresented in our sample, while mutual funds and asset managers are somewhat underrepresented. In terms of geographic distribution, our respondents are more likely to work for institutions in North America and Europe.

Our respondent group may be biased toward investors with a relatively high awareness of ESG topics in general (given the respondents' high average ESG share of 41%), as well as a high awareness of climate risks in particular, as such investors may be more disposed to participate in a climate survey (especially through our conference channel). In addition, some of our responses were obtained at ESG conferences. Nevertheless, understanding the views and preferences of such investors is particularly important, because they are more likely to shape future disclosure policies through industry initiatives (e.g., TCFD, CDP, or UN-PRI) or lobbying with regulators. Moreover, given that 27% of our survey participants have over $50 billion in assets under management (11% have over $100 billion) they have the clout to be effective in their engagement efforts. We consider this a strength rather than a weakness, as understanding the views and preferences of such investors is particularly important because they are more likely to shape future disclosure policies.

A related concern that may arise is that respondents could have answered our survey questions strategically or untruthfully. To mitigate this concern, in the survey introduction we guaranteed their anonymity. In particular, we did not request their identities or the identities of their employers, and we collected only limited information on their positions or their respondents' institutions.

[15] This approach has also been employed by Karolyi, Kim, and Liao (2019).

3. Evidence on Investors' Perceptions of Climate Risk Disclosures

3.1 Investors' Views on the Importance of Climate Risk Disclosures

As pointed out earlier, reporting on nonfinancial information through corporate sustainability reports or climate risk reporting can have benefits but also costs to a firm and its investors (Christensen, Hail, and Leuz 2019). On the one hand, disclosure in general has been shown to increase stock liquidity by alleviating adverse selection among investors, lower a firm's cost of capital and return volatility (Verrecchia 2001; Goldstein and Yang 2016). Moreover, research has shown that reporting on nonfinancial information can lower the cost of capital of portfolio firms (Plumlee et al. 2015; Matsumura, Prakash, and Vera-Muñoz 2018), and it may allow for better pricing and hedging of climate risks. On the other hand, disclosure can be costly. For example, a primary cost would result from disclosure that reveals proprietary information to competitors (Ellis, Fee, and Thomas 2012). While this cost may be less relevant for high level or aggregated disclosures, it could be substantial for detailed disclosures. For example, if a firm discloses detailed carbon reduction targets, this may allow competitors to infer a firm's future product market strategy. Another cost could arise from increased litigation risk (Matsumura, Prakash, and Vera-Muñoz 2014; Marinovic and Varas 2016). Further, Bushee and Noe (2001) provide evidence that increased disclosure can attract transient investors whose trading increases the return volatility of the firm's stock. In light of the potential benefits and costs of climate reporting, the importance that firm managers and investors attribute to this reporting is theoretically ambiguous.

To evaluate this theoretical ambiguity, we asked respondents to indicate how important they consider the reporting on firms' climate risks *relative to* the reporting on the firms' financial information (Question B1). The corresponding responses, reported in Figure 1, indicate that 51% of respondents believe that climate risk reporting is as important as financial reporting, and almost one-third even considers it to be more important. Only 22% of respondents regard climate risk reporting as less or much less important compared to financial reporting. Overall, these responses imply that disclosures related to a firm's climate risk exposure are considered important for the majority of institutional investors.

In Table 2, we examine cross-sectional differences in the responses to Question B1 to understand how investors vary in the extent to which they view the importance of climate-related disclosures. We hypothesize that the importance investors place on climate-related disclosures should be related to the relative importance they place on climate risk overall as well as how financially material they think each of the three components of climate risk (physical, technological and regulatory) to be. In addition, we predict that expectations about the extent of future climate change, measured through their forecasts of temperature changes, should also be an important factor. Finally, we hypothesize that the perceived importance of climate-related reporting should exhibit systematic variation across investor characteristics.

To examine these hypotheses, we conduct ordered logit regressions in which the dependent variable is the response to the question displayed in Figure 1, which is coded such that it varies between one (climate risk reporting is much less important compared to financial reporting) and five (climate risk reporting is much more important). The primary independent variables to potentially explain the response to this question are five investor responses to other survey questions (discussed below) as well as investor characteristics. As investor characteristics we consider investor horizon, investor size (assets under management), the ESG and the passive share of the investor's portfolio, whether an investor is an independent institution (Ferreira and Matos 2008), and the social and environmental norms in an investor's country (Dyck et al. 2019). We further include fixed effects for the respondents' positions in their institutions and for the distribution channels.

The first independent variable we consider is the importance the respondent attaches to climate risk itself, which we capture using the respondent's *Climate risk ranking*. To construct this variable, we asked the respondent to rank climate risk relative to other investment risks, such as traditional financial risks, operational risks, governance risks, social risks, and other environmental risks (see Question A1). The resulting variable ranges between one (climate risk is the most important risk) and six (climate risk is the least important risk).[16]

[16] The summary statistics are reported in Internet Appendix Table 1, Panel A. We find that the investors consider the other investment risks to be relatively more important. However, as explained in Krueger, Sautner and Starks

We report the results for *Climate risk ranking* in Table 2, Column (1), which shows that those investors who rank climate risks higher among other risks also believe that climate reporting is more important. The effects are economically meaningful. An investor who ranks climate risks one-standard deviation higher deems climate reporting 0.2 units more important, which equals about 22% of the variable's standard deviation (calculated for simplicity from an OLS regression).

We next decompose climate risk into its component parts, physical risk, regulatory risk and technological risk, to understand how investors' ratings of the financial materiality of these different risk components are related to their views on the importance of climate disclosure. As discussed earlier, climate change can affect the value of portfolio firms through three channels. Physical climate risks can affect firms because of temperature rises, severe weather events, droughts, or rises in sea levels. Regulatory risks encompass costs that result from regulations aimed at reducing the negative impacts of climate change.[17] Technological risks relate to climate-related technological disruption that may adversely affect portfolio firms. In our survey, we asked the investors to rate the financial materiality of each of these risks. We then construct three variables to measure the investors' assessments of these risks (*Regulatory climate risk, Physical climate risk,* and *Technological climate risk*). Each of the variables can vary between one (not at all important) and five (very important). We find the means to be close to 4, indicating the respondents, on average, consider these risks to be fairly important in terms of financial materiality. (See Internet Appendix Table 1, Panel A.)

In Table 2, Columns (2) to (4), we report estimates for whether the importance of climate disclosure varies across investors based on how financially material they perceive each of these three risks to be. The results show that for each type of climate risk investors who deem it to be more financially material, also attach greater importance to climate reporting. This finding is consistent with the survey results for a related but different survey question reported in Amel-Zadeh and Serafeim (2018). They find that investment

(2020), overall, investors consider climate risks to be important risks given that they rate the three types of climate risk (physical, regulatory, and technological) as being important risks on their own.

[17] Examples for such regulation include a carbon tax such as the one proposed in the *Economists Statement on Carbon Dividends,* signed by over 3,500 economists https://www.clcouncil.org/.

professionals consider ESG information financially material to investment performance. Most interestingly, the three coefficient estimates in Columns (2) to (4) differ substantially in magnitude. The estimate in Column (4) on *Physical climate risk* is almost 2.5 times as large as the estimate on *Regulatory climate risk* in Column (3). In a similar but less pronounced way, the estimate on *Technological climate risks* in Column (4) is substantially larger than the estimate on *Regulatory climate risk* in Column (3).[18] These differences suggest that disclosure is seen as most important when it comes to physical climate risks, followed by technological and then regulatory risks.

The strong role of physical risks in explaining the importance of climate disclosure may be due to the fact that such risks tend to be more firm and location specific, requiring relatively precise information about a firm's exposure for evaluation. Thus, investors generally have lesser ability to gather the information and greater need for firm disclosure. In contrast, regulatory climate risks are more firm independent and regulator dependent, and information on such risks may be easier to obtain since firms in the same industry and country face similar regulatory risks (e.g., information could also be obtained from competitors).[19]

Another factor that could help explain investors' perceived importance regarding climate reporting lies in their climate change expectations. To elicit these expectations through the survey, we used the 2°C target of the Paris Climate Accord as an anchor and asked the respondents about their own global temperature expectations by the turn of this century (Question E1).[20] Responses could vary between one (no expectation of a temperature rise) and five (more than 3°C expected). Across all respondents, only 3% do not expect any temperature increase by 2100, 16% expect an increase by up to 1°C, and 30% by up to 2°C.

[18] As the distributions of the three risk variables are almost identical (see Appendix Table 1, Panel A), we can directly compare the coefficient estimates to evaluate their relative importance. The coefficient on *Regulatory climate risk* is statistically different from those on *Physical climate risk* and *Technological climate risk*, while the latter two do not differ statistically.

[19] In addition, Krueger, Sautner, and Starks (2020) show that a relatively large fraction of investors believe that regulatory climate risks have already started materializing, while physical and technological risks are expected to materialize over somewhat longer horizons. The more immediate character of regulatory risks might therefore imply that disclosure about them is less important than information about (potentially more distant) technological and physical risks.

[20] Under the 2015 Paris Climate Accord, 195 countries agreed to take significant measures to keep the global temperature rise under 2°C by the end of this century.

Four in ten respondents expect a temperature rise that exceeds the Paris 2°C target, with 12% expecting an increase of more than 3°C.

The results, reported in Column (5), show that personal climate expectations appear highly relevant for explaining the investors' opinions on the importance of climate reporting: Investors who expect a higher temperature rise also consider climate reporting to be more important. A one-standard deviation increase in the expected temperature rise, which corresponds to moving up one notch in the possible response category, is associated with a 0.17 higher value for the importance attached to climate disclosures (18% of the variable's standard deviation; obtained again from OLS estimates).

These results on the associations between investors' perceived importance of climate-related disclosures for their portfolio firms and their beliefs about the importance of climate risk and its components as well as their expectations of temperature changes also serve as an internal validation of the survey itself.

Certain investor characteristics would be expected to be associated with investor views on climate-related disclosures. The first is investor horizon. Besides showing a link between transient investors and increased disclosure, Bushee and Noe (2001) argue that investors with longer-term horizons would not be as concerned with financial disclosure because they would not value the increased liquidity since they trade infrequently. On the other hand, Starks, Venkat and Zhu (2020) find that investors with long-term horizons weight their portfolios toward higher ESG firms, and Flammer, Toffel, and Viswanathan (2019) conclude that environmental shareholder activism regarding climate risk disclosure is particularly effective if it is initiated by long-term institutional investors. These results suggest that longer-term investors may particularly value climate-related disclosure. The results reported in Table 2 on investor horizon, however, indicate that medium- and long-term investors do not differ from short-term investors in their perceptions of the importance of climate reporting. These results possibly derive because the investors have offsetting preferences.

A second potentially important investor characteristic is the size of the investor's assets under management. Larger investors tend to be universal owners whose broad-ranging

ownership makes them more susceptible to climate risk. We would thus expect them to have greater interest in climate-related disclosure. The significantly positive coefficient on investor size in Table 2 supports this hypothesis as the investors with more assets under management place more importance on climate reporting. Similarly, ESG-oriented investors would be expected to consider climate reporting to be important because the investment mandate of such investors includes environmental considerations. Our results are consistent with this supposition.

Finally, the locations of the institutional investors would be expected to be influential in considerations of climate-related disclosures because of differences in social norms across countries. In Williamson's (2000) framework for four levels of institutional influences in economic activity, the most fundamental are social norms and cultural influences – the informal institutions, customs, traditions, norms and religion. Similarly, Guiso, Sapienza, and Zingales (2006) discuss the link between culture and economic outcomes, which they define as "*those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation*." Thus, we expect that investors' views on the importance of climate disclosure will be based in part on whether they are located in countries in which social norms would make the investors more climate-conscious. As a proxy for a climate-conscious country, we use a measure of environmental awareness, the Environmental Performance Index (EPI), which has been used by Dyck et al. (2019) to proxy for environmental norms in a country. The EPI, developed by the Yale Center for Environmental Law and Policy as a summary of the state of sustainability in countries, uses 32 performance indicators across 11 issue categories to rank 180 countries on their environmental health and ecosystem vitality.[21] We define a country as being in the high (low) social norms group if its EPI is higher (lower) than the median in a given year. In some of the specifications in Table 2, we find that more importance is placed on climate risk reporting when the social norms are higher (i.e., EPI is higher). The lack of significance for some of the specifications may be due to the correlations between the EPI measure on the one hand and

[21] https://epi.yale.edu/about-epi

the perceived regulatory risk ranking as well as the temperature expectations on the other hand.

3.2 Investors' Evaluations of Current Disclosure Practices

As discussed in the previous subsection, theory and archival evidence suggest that while firms' nonfinancial information, and in this case, climate risk disclosure, could add value to firms, there are also potential costs, leading to a somewhat ambiguous expectation. Our results as displayed in Figure 1 and Table 2 support the hypothesis that investors, on average, believe such reporting has value, but that systematic variations in this belief exist across the investors depending on their climate risk and temperature expectations as well as their characteristics. A related issue is that uncertainty still exists for firms, investors, and regulators regarding how much should be disclosed given that the disclosure is largely voluntary and unstandardized.[22] The considerations include whether the disclosures should be qualitative, that is, whether they should consist of narratives regarding how climate change affects business models or how climate risks are governed, and whether they should be quantitative and take account of hard data on emissions or emissions reduction targets. To assess investors' views on these types of disclosures, in Question B3 respondents were asked to indicate their agreement with a set of statements on a scale of one ("strongly disagree") through five ("strongly agree").

The responses, reported in Table 3, demonstrate a widespread view that current quantitative and qualitative disclosures are imprecise and not sufficiently informative. Specifically, many of our respondents strongly agree that management discussions on climate risks (20.8% strongly agree) as well as quantitative information on these risks (19.4% strongly agree) are not sufficiently precise. Further, the average response to each question is significantly higher than the neutral response to the question. These results suggest that the current voluntary reporting regime does not enable fully informed investment decisions, at

[22] To the best of our knowledge, the only country that compels all companies to follow a mandatory and prescriptive climate disclosure regime is the U.K., which introduced this with *The Companies Act 2006*, Regulations 2013). For an analysis of the U.K. regulation see Krueger (2015).

least for firms with large exposures to climate risks. This could be one reason why climate risks are considered difficult to price in equity markets, an issue we address below.

The responses to the previous two questions indicate that many firms currently do not consider the net benefits of reporting on climate risks to be sufficiently high, as they would otherwise reveal such information voluntarily. At the same time, investors seem to value such information as indicated by their responses, which suggests that the investors believe that the benefits of disclosure would outweigh costs to the firms, consistent with the overall theoretical predictions discussed in Goldstein and Yang (2017) and Christensen, Hail, and Leuz (2019).

These seemingly diverse perspectives between firms and their investors raise the question of whether mandatory and standardized reporting on climate risks is needed. In general, the economic rationale for mandatory disclosure regulation on climate risks requires the existence of externalities or market-wide cost savings that regulations can mitigate (Shleifer 2005). A firm's contribution to climate change could be viewed as such an externality. Standardization of climate reporting would make it easier and less costly for investors to acquire and interpret information relevant to evaluating a firm's climate risk. It could, thus, facilitate cross-firm and cross-industry benchmarking. A mandatory disclosure regime could also provide commitment and credibility for firms' climate disclosure, especially if the standards are specific and well enforced (Christensen, Hail, and Leuz 2019).

Indeed, Table 3 documents that many investors believe that standardized and mandatory reporting on climate risk is necessary (26.9% strongly agree and the average response is significantly greater than the neutral response). Similarly, there exists a widespread view that more standardization in climate-related financial disclosure across markets is warranted (27.4% strongly agree and the average response is significantly greater than the neutral response). However, a significant challenge for changing the current reporting environment seems to be that standardized disclosure tools and guidelines are not yet widely available (21.3% strongly agree). Although our respondents on average agree that standardized and mandatory reporting of climate risk is necessary, the fact that there exists variation across the answer, with some investors disagreeing, suggests that these investors

either do not see the value in such reporting or believe that the costs of such reporting outweigh the benefits. Support for this latter potential explanation comes from evidence provided by Jayaraman and Wu (2019) that beyond providing informational benefits, mandatory disclosure can also impose real costs on firms.

Overall, our respondents' views are consistent with recent initiatives that increase transparency on climate risks. For example, in June 2017, the TCFD released its recommendations on climate-related financial disclosures, which centers on the role of climate risks for a firm's governance, strategy, and risk management, and how climate risks are reflected in metrics and targets. Using this comprehensive approach, the TCFD recommendations go beyond simply disclosing carbon emissions.

Although complying with the TCFD recommendations is currently voluntary, recent developments suggest that these recommendations could eventually constitute the basis for mandatory and standardized climate disclosure in many countries. For example, in January 2018, a large group of central banks and supervisors formed the Network for Greening the Financial System, with the purpose of defining and promoting best practices in the development of environment and climate risk management in the financial sector and to mobilize mainstream finance to support the transition toward a sustainable economy. Institutional investors have already begun to develop initiatives on their own to improve the climate risk of their portfolios and to access climate risk data. For example, institutional investors have formed organizations such as the Portfolio Decarbonization Coalition, the Montreal Carbon Pledge, Transitions Pathway Initiative, and Climate Action 100+. These initiatives are focused on climate risk in institutional investor portfolios, with some intent on reducing the carbon footprint of portfolios and others intent on engaging the largest greenhouse gas emitters to minimize and disclose their climate risk exposures. Consistent with these initiatives, many of our respondents hold the strong belief that investors should put pressure on firms to disclose more on their climate risks (27.6% strongly agree), which also echoes the recent investor initiatives at Exxon Mobil and Occidental Petroleum discussed earlier. This view of our respondents is also in line with the increasing role that climate-related topics played in the most recent proxy seasons (Ceres 2018, 2019).

Using ordered logit regression analysis we examine whether systematic variations exist in the institutional investors' responses to the qualitative statements on current practices of climate-related disclosures. In particular, we are interested in whether the investors who strongly agree with the statements also believe climate risks to be financially material. Thus, the dependent variables are dichotomous categorizations of investor responses to the questions and equal one if a respondent indicates "strong agreement" with a statement on the current disclosure practices, and zero otherwise. The main explanatory variable is *Climate risk financial materiality*, which measures how respondents evaluate the financial effects of climate risks (Question A2). This variable averages the responses to the three questions about the materiality of regulatory, physical, and technological climate risks, and ranges between one ("not at all important") and five ("very important").

We report the results of these regressions in Table 4. Columns (1) and (2) indicate that investors who believe that climate risks are more financially material also think more strongly that current information on climate risks is imprecise and uninformative. These investors also believe more strongly that there should be more standardization and mandatory requirements in climate disclosures (see Columns (3) and (4)). The results in Column (7) further suggest that investors who believe strongly that climate risks matter also strongly believe that investors should demand better disclosure from portfolio firms.

We also find systematic differences in responses across investor characteristics. Those investors with portfolios more subject to ESG integration believe more strongly that quantitative information on climate risks is imprecise. They also tend to agree more strongly that management discussions and disclosure forms are lacking in quality and informativeness. In addition, investors with a greater portfolio share of assets under ESG integration believe more strongly that tools and guidelines for standardized disclosure are currently not available.

3.3 Investors' Views on Initiatives on Climate Risk Disclosure

We use two questions to evaluate how investors view recent initiatives on climate risk disclosure. These initiatives arise from an institutional investor group and from a government. We first asked whether the investors engage or plan to engage portfolio firms to report in

accordance with the TCFD recommendations (Question E5). This question is related to Question B3, where investors indicated that they should demand that their portfolio firms disclose their exposure to climate risk (as shown in Table 3, we found a mean score of 3.90 for this question). Moreover, major investors have announced this topic as a prime area for their shareholder engagement (Blackrock 2017). Figure 2 demonstrates that this approach is shared widely, as 59% of investors (plan to) engage firms on this topic. Interestingly, a quarter of our survey participants responded with "Do not know," which could indicate that these institutional investors have not made a decision on this type of engagement yet or perhaps that they are not familiar enough with the recommendations.

In the second question, we asked the investors to give their opinions regarding a new investor practice championed by a French law, which since 2016 requires that asset owners and investment managers report on the carbon in their portfolios (Article 173 of the Energy Transition for Green Growth Law).[23] Our respondents in general indicate support for this approach, which is considered one of the most ambitious climate risk regulations in the world: 60% of the investors stated in response to Question B2 that they already disclose or plan to disclose the carbon footprint of their investment portfolios (Figure 3). This result also speaks to ongoing policy efforts at the European Union level. Under Article 7 of the European Commission's action plan on sustainable finance, there exists discussion on amending EU Directive 2016/2341 (IORP 2-Pensions), which would require increased disclosures by institutional investors relating to sustainability risks.

In order to understand the cross-sectional differences in the investor responses, we conduct regressions using investor characteristics to explain the investors' behavior in terms of actions according to these initiatives. We use two dependent variables: *TCFD engagement* equals one if an investor engages (or plans to engage) portfolio firms to report according to the recommendations of the TCFD. *Carbon footprint* equals one if an investor discloses (or plans to disclose) the carbon footprint of their portfolio, and zero if not.

[23] See "France Gets Climate Risks Disclosures from Invest Firms," *Wall Street Journal*, December 7, 2017. The law also requires investors to report on how they identify and manage climate risks.

We report the results in Table 5. Column (1) indicates that investors with greater ESG shares are more likely to engage firms to report according to the TCFD recommendations. Moreover, investors located in countries with higher social norms regarding environmental issues are more likely to engage firms over climate disclosure, consistent with Dyck et al. (2019). We do not find that investors differ in their likelihood of engaging firms along dimensions of their beliefs in climate risk financial materiality, their investment horizons, or their assets under management. This suggests that engagement regarding the adoption of these recommendations is widespread among a variety of institutional investors.

The results in Column (2) of Table 5 suggest that investors who believe more strongly that climate risks are financially material are also more likely to disclose the carbon footprint of their portfolios. Investors with more assets under management, and investors whose portfolios have higher ESG shares, are also more likely to disclose their carbon footprints. These findings are intuitive as one would expect that investors have stronger incentives to make the carbon footprint of their portfolios publicly available if they believe in the materiality of climate risks and if they are more ESG oriented. To the extent that calculating and disclosing the carbon footprints of portfolios is costly, it is also unsurprising that larger institutions are more likely to do so (perhaps because they have more financial resources). Larger investors might also face more scrutiny by stakeholders on these issues, making them more likely to initiate actions. The latter argument is consistent with Krueger, Sautner, and Starks (2020), who find that reputational concerns are one of the key drivers for institutions to incorporate climate risks into the investment process. Contrary to what might be expected, medium- and long-term investors have a lower propensity to disclose the portfolio footprint compared to short-term investors.

We also examine whether and how the adoptions of the initiatives in climate disclosure relate to investor demand about more and better climate reporting. First, we examine whether investors who plan to engage firms to report according to the TCFD recommendations see a stronger need for better quality, and more standardized, disclosures. Second, we test whether investors who plan to disclose the portfolio carbon footprint want

more high-quality reporting on climate risks, and whether they believe more strongly that investors should demand climate disclosures from portfolio firms.

Table 6 reports regression results which use as independent variables the two indicators that capture the adoption of initiatives in climate reporting, namely *TCFD engagement* and *Carbon footprint*. We use these variables to explain the respondents' perceptions of whether institutions should demand climate disclosure from portfolio firms; the quantity and quality of current climate disclosure; and the importance of standardized and mandatory reporting requirements (Question B3).

The table indicates that investors who (plan to) disclose their portfolio carbon footprint see a bigger role for demanding more disclosure about climate risks, and believe that such disclosures should be more standardized and mandatory. Investors planning or already disclosing their portfolio footprints also believe more strongly that management discussions about climate risks are imprecise. These results are not surprising given that such information would be necessary to calculate the carbon footprints of their portfolios, which is consistent with the idea that, to disclose a portfolio footprint, standardized issuer-level information is required and that such data are often not available for all firms in the same format.[24] However, given that calculating portfolio carbon footprints primarily requires quantitative information, we find surprisingly little evidence that investors who disclose their footprints perceive current quantitative information as imprecise. This is possibly the result of initiatives such as the CDP, which collects emissions data by means of a survey. Overall, investors that plan to engage firms to report according to the TCFD recommendations see a stronger need for more disclosure, and they also believe more strongly that disclosure should be standardized and mandatory. On the other hand, such investors do not seem to think that current quantitative information or management discussions are imprecise. One interpretation of this evidence is that investors view the TCFD recommendations as a way to impose structure on climate risk reporting (rather than to obtain more precise information).

[24] This interpretation is echoing the concern by Yngve Slyngstad of Norges Bank Investment Management (cited in the Introduction). Indeed, Jouvenot and Krueger (2019) show that mandatory and prescriptive carbon requirements dramatically increase the availability of carbon data at the issuer level.

3.4 Investors' Views on Climate Risk Disclosure and Climate Risk Mispricing

An important role for climate risk disclosure is in correcting mispricing, which, according to recent research, may be present in equity markets. For example, Hong, Li, and Xu (2019) provide evidence suggesting that markets underreact to climate risks because of poor disclosure, implying that improved disclosures could reduce the mispricing. In addition, Daniel, Litterman, and Wagner (2018) develop a theoretical model in which uncertainty about the effect of CO_2 emissions on global temperature (and on eventual damages from climate change) gradually resolves over time. Their model suggests a high carbon price today that should decline over time as uncertainty about climate risks resolves. One mechanism through which these uncertainties disappear is via climate risk disclosures. As firms evaluate the risks climate change poses on their business models and make their assessments public, equity prices converge towards their fair valuations through the harmonization and comparability benefits of disclosures.

To develop measures on climate risk mispricing, we asked the institutional investors whether they believe that current equity valuations in different sectors of the economy correctly reflect the risks and opportunities related to climate change (Question D1).[25] Specifically, we asked them whether they think each of the individual sectors potentially most affected by climate change are overvalued or undervalued. We designate the responses for each sector as ranging from plus two (for valuations much too high) to minus two (for valuations much too low). Figure 4 reports the mean responses, showing that overvaluations are highest in the oil and automotive sector. We use these data to create two variables that aggregate the responses across the sectors. For each respondent, *Climate risk underpricing* averages all positive mispricing scores across sectors (score of one or two), to capture the extent to which a respondent believes that climate-related overvaluation exists in the market (negative scores are set to zero). We find that the average respondent believes that equity valuations in the average sector do not fully reflect the risks from climate change, as the mean

[25] We allowed for over- and undervaluation of market prices across different sectors as some sectors may be overvalued (e.g., the oil or coal sectors), while other sectors may be undervalued (e.g., the battery producers, water utilities). Krueger, Sautner, and Starks (2020) provide more discussion on how the perceived overvaluation varies across sectors.

of *Climate risk underpricing* exceeds zero. (See Internet Appendix Table 1, Panel A.) Relatedly, to capture nondirectional mispricing, we define *Climate risk mispricing* to be the average for each respondent of the *absolute* values of their mispricing scores across all sectors.

In order to estimate whether investors' views on climate disclosure help explain any perceived climate risk mispricing, we develop three independent variables to capture the respondents' views on the quantity and quality of current climate reporting. The first variable (*Demand more disclosure*) measures whether a respondent "strongly agrees" that investors should demand more disclosure from portfolio firms about their exposure to climate risks. The other two variables capture perceptions about the quality of available climate information, both in terms of hard (*Quantitative information imprecise*) and soft information (*Management discussion imprecise*).

We report the results in Table 7. The estimates in Column (1) indicate that respondents who more strongly agree that investors should demand disclosure on climate risks also believe there exist stronger overvaluations in equity market pricing in general for the sectors most affected by climate change. In terms of magnitudes, the climate risk-related overvaluations perceived by these investors are 33% higher, relative to the mean overvaluation score of 0.6. The results in Column (2) indicate that investors who believe that the available quantitative information about climate risks are imprecise have more perceived overvaluation in these sectors. As shown in Column (3) we find similar results for investors who think that management discussions on climate risk are not sufficiently precise. Taken together, these results suggest that a lack of hard and soft information on climate risks contributes to the perception of climate risk underpricing in equity markets.

Columns (4) to (6) confirm these results using the measure that captures both directions of mispricing. The fact that we find similar effects for this alternative variable suggests that better climate disclosure is useful in alleviating both directions of climate risk mispricing, i.e., the underpricing and overpricing of climate risks. Overall, the results in Table 7 suggest that the demand for climate-related information, and beliefs about the quality of climate-related disclosure, are associated with mispricing in equity markets, at least as perceived by our respondents. A striking implication of this evidence is that better disclosure

can contribute to a more efficient pricing of climate risks, which is consistent with the theoretical predictions on disclosure more generally as shown in Goldstein and Yang (2017).

4. Institutional Ownership and Portfolio Firms' Climate Risk Disclosure

4.1 Institutional Ownership and Voluntary Disclosure of Carbon Emissions

The survey responses indicate that institutional investors value firm disclosures on climate risks and increasingly engage with portfolio firms to encourage such disclosures. To further analyze and support the survey analysis, we use observational data on firms' carbon disclosures along with their institutional investors' ownership to test empirical predictions that follow from theory as well as our survey responses. As discussed earlier, one rationale for the lack of voluntary disclosure may be unwarranted costs on a firm (Verrecchia 1983, 1990; Bond and Goldstein 2018). Given that firms are not obliged by regulation or accounting standards to disclose their emissions to the CDP or other institutions, many firms decide not to do so.[26] Yet Jayaraman and Wu (2020) provide evidence that firms may choose to voluntarily disclose proprietary information in order to learn from stock prices, which would also be consistent with the literature on disclosure discussed previously (e.g., Goldstein and Yang 2017; Christensen, Hail, Leuz 2019). Given these conflicting predictions, the question remains as to which firms choose to disclose.

Our survey indicates that information on climate risk in general, and carbon emission in particular, is considered valuable to a firms' major investors and that many of these investors may be engaging the firms to provide this information. Thus, the first hypothesis we test is whether the propensity to voluntarily disclose carbon emissions is greater among firms with higher institutional ownership. To examine this prediction, we first identify whether firms voluntarily disclose their carbon emissions to the CDP, which as pointed out earlier, is a non-profit organization that performs annual surveys among firms to collect emissions data. The CDP collects these data on behalf of institutional investors representing over $100 trillion

[26] A notable exception is the U.K., where mandatory carbon emissions disclosure in firms' annual reports was introduced for large listed companies in 2013 (see Krueger 2015 and Jouvenot and Krueger 2019). Through the Streamlined Energy and Carbon Reporting (SECR) policy, the U.K. government has recently extended this mandatory disclosure requirements to all firms.

in assets under management. The CDP provides the main source of carbon emissions data and many institutional investors use these data for their climate risk management (Krueger, Sautner, and Starks 2020). Likewise, leading ESG data providers employ the CDP data as input for rating models (e.g., MSCI ESG Research, Bloomberg, Refinitiv, or Sustainalytics).

To create a global sample of firms for this analysis, we start with all firms in the international Worldscope/Datastream universe between 2009 and 2017. A challenge with using this initial set of firms is that the CDP does not reveal which firms they contacted to request the carbon information. Therefore, we follow the approach in Krueger (2015) and create a subsample of firms that the CDP likely contacted based on their size relative to other firms in their respective countries.[27] We then classify firms into disclosing and nondisclosing firms based on data by the CDP. We obtain information on firms' institutional ownership from FactSet. Summary statistics are reported in Internet Appendix Table 1, Panel B.

We focus on firms' disclosure of Scope 1 carbon emissions because these emissions are the most easily measured and reported. Scope 1 emissions are direct emissions from owned or controlled sources of the disclosing company.[28] Table 8 reports the regressions results in which the dependent variable is *Scope 1 disclosure*, which equals one if a firm voluntarily discloses Scope 1 emissions to the CDP in a given year, and zero otherwise. In Column (1), the independent variable of interest is *Total IO*, which is the fraction of a firm's equity that is owned by institutional investors. We report results with and without industry-by-year fixed effects and we estimate OLS models as logit models do not converge due to the large number of fixed effects. The estimates reported in Column (1) reveal a significantly positive association between voluntary Scope 1 disclosure and institutional ownership. The effects are large: a one-standard deviation increase in *Total IO* increases the probability of disclosing emissions by 14%, which equals about 83% of the unconditional mean of the variable. These results are consistent with our survey results which show that institutional investors consider climate risk reporting to be important.

[27] As in Krueger (2015), we take, for example, the largest 500 firms from the U.S., the 725 largest firms from the U.K, the top 500 from Japan, the top 250 from France, etc.

[28] These emissions are distinct from Scope 2 and Scope 3 emissions, which are either indirect emissions from the generation of purchased energy (Scope 2), or all indirect emissions (except those included in Scope 2) that occur in the value chain (Scope 3).

We recognize that this positive relationship between institutional ownership in a firm and the firm's voluntary decision to produce carbon emissions data could exist for two reasons. First, as the institutional investors in our survey indicate they actively engage firms to disclose their climate risks, we expect that firms with more institutional investors would be more likely to have had such engagements and consequently more likely to have institutional investors demand these data be produced. Second, the relationship could potentially arise from the opposite direction because as the survey responses show, institutional investors are more likely to invest in firms that provide such disclosures. Thus, we are not claiming that these results provide evidence of causality, rather we are establishing a relationship consistent with a prediction that arises from our survey of investors' views on climate reporting.

We also further test the hypothesis that social norms affect investor views on the importance of climate disclosure. In the survey responses, we find some support for this hypothesis in that several specifications showed systematic differences across institutional investors based on the social norms of their headquarter country locations. Using the observational data, we test the hypothesis that the propensity to disclose emissions depends on the extent to which a firm's institutional owners are located in countries with high social norms for climate, where we stratify ownership according to whether institutions are headquartered in countries with high or low social norms. That is, we measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI). An investor's country is in the high (low) social norms group if its EPI is higher (lower) than the median in a given year. *High social norms IO* (*Low social norms IO*) measures the percentage of a firm's equity owned by institutions from high (low) norm countries.

The estimates in Table 8, Column (2) show that the effect in Column (1) originates mostly from institutional owners located in high social norms countries; ownership from low social norms countries does not seem to matter. Columns (3) and (4), show that the results in Columns (1) and (2) are robust to accounting for disclosure trends within a given industry and year. In Internet Appendix Table 2, we obtain similar results when we replace Scope 1 disclosure with Scope 2 (Scope 3) disclosure.

These results support the hypothesis that the choice of voluntary disclosure depends on the institutional ownership in a firm, suggesting that institutional investors have influence on firms' carbon disclosures, whether from an engagement or an attraction direction. The results are also consistent with the findings in Dyck et al. (2019) regarding the influence of institutional investors from high social norms countries on firms' environmental and social performance. Our results also support the reputational externality argument of Ramadorai and Zeni (2020) to explain why abatement activities vary across firms in that we find that the firms that disclose more are owned by investors from high social norms countries.

4.2 Institutional Ownership and the Quality of Voluntary Carbon Disclosures

An impediment to voluntary disclosure is the need for assurance that the disclosure is truthful, that it is of high quality, and such verification is a fundamental aspect of financial reporting. Moreover, Flammer (2020) finds a stronger investor response to the announcement of green bond issuance, when the bonds are certified by a third party. Further, our survey results indicate that the investors on average believe that firm-level quantitative information on climate risks is not sufficiently precise and that standardized and mandatory reporting on climate risks is necessary. These results suggest that we should find a higher likelihood of verification. Therefore, in a second test, we examine whether the *quality* of carbon information among firms with greater institutional ownership, where we define quality by whether the information is verified.

When firms voluntarily disclose their carbon emissions to the CDP, they are also asked whether a third party has verified the reported emissions. We measure such verification by creating the integer-valued variable *Emissions verification*, which takes values between zero and three, with three indicating that a firm obtained external verification of its reported Scope 1, Scope 2, and Scope 3 emissions, and zero that a firm does not obtain any such verification (or that it does not disclose emissions at all). The variable takes the intermediate values (of one and two) if a firm obtains verification on one or two of the emissions types only. (In most cases, firms verify all three emissions types jointly.) We interpret the resulting variable as a measure of disclosure quality.

We report the results in Table 9. Again, we find that social norms are important in the relationship between verification of carbon disclosures and institutional ownership. Although as shown in Column (1), no significant relationship exists between emissions verification and total institutional ownership, this pattern changes sharply in Column (2), where we find that higher ownership by institutions from high social norms countries is positively associated with disclosure verification. Interestingly, the reverse seems true for ownership from low norm countries, though this effect turns insignificant with industry-by-year fixed effects. Overall, the verification tests highlight the importance of verification with voluntary disclosure and support prior research on the relationship between institutional investor ownership and environmental performance (e.g., Dyck et al. 2019).

4.3 Effects of Domestic versus Local Institutional Ownership

One concern with the analyses in Tables 8 and 9 is that the results may reflect a form of "home bias", that is, the fact that high social norms investors are more invested in local firms, who also happen to have better climate disclosure policies. On the other hand, Dyck et al. (2019) find that the influence of foreign institutional investor ownership is particularly important in the relationship with environmental and social performance. To examine which channel is driving our results on the relationship between institutional ownership and carbon emission disclosure and verification, we divide institutional ownership at the firm level into its foreign and local components. We perform the same decomposition for the high and low norm components of institutional ownership. Table 10 shows for *Scope 1 disclosure* that foreign ownership from high social norms countries drives the results: while both components of high social norms ownership are positively associated with more disclosure, the point estimates of the foreign component are about twice as large as those of the local component. Table 11 presents a similar picture for *Emissions verification*.

5. Conclusion

Given the ambiguity in whether disclosure is beneficial for firms and their investors (e.g., Goldstein and Yang 2017), we employ a global survey of institutional investors to

examine their perceptions and actions regarding the climate risk disclosures of their portfolio firms. A large majority of our respondents believes that climate risk reporting by portfolio firms is important. In fact, many respondents consider it as important, or even more important, than reporting on traditional financial risks. At the same time, a widespread view exists that climate risk disclosure needs improvement, particularly in terms of the availability and quality of hard and soft climate-related information. Many investors further believe that firm-level reporting should be more standardized and mandatory.

In cross-sectional tests, we find that the investors who think that climate risks are more financially material also deem climate disclosure to be more important. In a similar spirit, investors who expect higher future global temperatures also believe that climate disclosure is more important. Our analysis suggests that firm-level disclosure is more important for assessing physical and technological climate risks, and less so for regulatory risks.

The views on the availability and quality of climate-related disclosures are associated with investor-level perceptions of climate risk mispricing in the equity market. Respondents who believe that investors should require firms to report on climate risks, and investors who regard both quantitative and qualitative climate information to be insufficient, perceive more mispricing in current equity valuations. Finally, the majority of our respondents plans to engage portfolio firms to report according to the TCFD recommendations. A majority of investors also discloses or plans to disclose the carbon footprint of their own investment portfolio.

We support and extend our survey analysis by using observational data to examine implications derived from theory as well as the survey responses. We show that the propensity to voluntarily disclose carbon emissions is larger among firms with higher institutional ownership, in particular if such ownership originates from countries with high environmental norms. The presence of institutional owners from countries with high environmental norms is also related to the quality of carbon disclosures. This evidence supports our interpretations from the survey that institutional investors value climate

disclosure and increasingly engage firms on such disclosures, whether because they are attracted to firms with such disclosures, they push firms to make those disclosures or both.

Our analysis is important because through our survey and empirical evidence we are able to shed more light on important investor perspectives and actions. This enables us to contribute to the emerging literature on climate finance and, more generally, to the literature on nonfinancial disclosure.

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Data Appendix

Variable	Definition	Survey Question
Importance of climate risk disclosure	This variable measures how important investors consider reporting by portfolio firms on climate risks compared to reporting on financial information. The variable ranges between one and five, with one indicating that climate risk reporting is "much less importance" and five indicating that it is "much more important".	Question B1
Climate risk ranking	This variable is the outcome of a ranking of the importance of climate risks relative to other more standard investment risks. The variable ranges from one (if climate risks are considered the most important risk) to six (if they are considered the least important risk).	Question A1
Regulatory climate risk	This variable measures the financial materiality of regulatory climate risk. The variable can range between one (not at all important) and five (very important).	Question A2
Physical climate risk	This variable measures the financial materiality of physical climate risk. The variable can range between one (not at all important) and five (very important).	Question A2
Technological climate risk	This variable measures the financial materiality of technological climate risk. The variable can range between one (not at all important) and five (very important).	Question A2
Temperature rise expectation	*Temperature rise expectation* measures investors' expectations about what the global temperature rise will be by the end of the 21st century. This variable can vary between one (no expectation of a temperature rise) and five (more than 3°C expected).	Question E1
Climate risk financial materiality	This variable averages the responses to three questions about the financial materiality of regulatory, physical, and technological climate risk. Each of these three variables can range between one (not at all important) and five (very important).	Question A2
Management discussions imprecise	This variable takes the value of one if a respondent "strongly agrees" that management discussions on climate risk are not sufficiently precise, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
Quant. information imprecise	This variable takes the value of one if a respondent "strongly agrees" that firm-level quantitative information on climate risk is not sufficiently precise, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
Stand. and mandatory reporting necessary	This variable takes the value of one if a respondent "strongly agrees" that standardized and mandatory reporting on climate risk is necessary, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
More standardization across markets	This variable takes the value of one if a respondent "strongly agrees" that there should be more standardization across markets in climate-related financial disclosure, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
Standardized tools not available	This variable takes the value of one if a respondent "strongly agrees" that standardized disclosure tools and guidelines are currently not available, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3

Disclosure forms not sufficiently informative	This variable takes the value of one if a respondent "strongly agrees" that mandatory disclosure forms are not sufficiently informative regarding climate risk, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
Demand more disclosure	This variable takes the value of one if a respondent "strongly agrees" that investors should demand that portfolio firms disclose their exposure to climate risk, and zero otherwise. In the underlying questions, respondents were asked to indicate their agreement with the statements on a scale of one ("strongly disagree") through five ("strongly agree").	Question B3
Climate risk underpricing	This variable averages positive mispricing scores (negative scores are set to zero). The variable ranges between plus two (strong average overvaluation) and zero (no average overvaluation).	Question D1
Climate risk mispricing	This variable averages the absolute values of all mispricing scores and can take the values of zero, one, and two.	Question D1
Carbon footprint	This variable takes the value of one if a respondent discloses or plans to disclose the overall carbon footprint of their portfolio, and zero otherwise.	Question B2
TCFD engagement	This variable takes the value of one if a respondent engages or plans to engage portfolio companies to report according to the recommendations of the Task Force on Climate-related Financial Disclosures, and zero otherwise.	Question E5
Medium-term horizon	This variable takes the value one if the indicated typical holding period of an institutional investor is between six months and two years, and zero otherwise.	Question G2
Long-term horizon	This variable takes the value one if the indicated holding period of an institutional investor is above two years, and zero otherwise.	Question G2
Assets under management	This variable indicates the size of an institutional investor and takes the values of one (assets under management less than $1bn); two (between $1bn and $20bn); three (between $20bn and $50bn); four (between $50bn and $100bn); and five (more than $100bn).	Question G6
ESG share of portfolio	This variable is the percentage of the institution's portfolio that incorporates ESG issues	Question G5
Passive share of portfolio	This variable is the percentage of the institution's portfolio that is passively managed.	Question G4
Independent institution	This variable takes the value one if an institutional investor is considered to be an independent institution, and zero otherwise. As in Ferreira and Matos (2008) and Dyck et al. (2019), independent institutions are more likely to collect information, have fewer potential business relationships with the corporations they invest in, and therefore are anticipated to be more involved in monitoring management. We classify mutual funds, asset managers, hedge funds, private equity funds, and public pension funds as independent institutions.	Question G1
HQ country social norms	This variable captures the importance of environmental issues in the country in which an institutional investor is headquartered. The data are from Dyck et al. (2019), who construct the variable based on the Environmental Performance Index obtained from the Yale Center for Environmental Law (Yale University) and the Center for International Earth Science Information Network (Columbia University) for 2004. Larger numbers reflect a stronger common belief in the importance of environmental issues.	Question G7
Scope 1 disclosure	This variable takes the value one if a firm discloses Scope 1 carbon emissions to the CDP in a given year, and zero otherwise	CDP

Scope 2 disclosure	This variable takes the value one if a firm discloses Scope 2 carbon emissions to the CDP in a given year, and zero otherwise	CDP
Scope 3 disclosure	This variable takes the value one if a firm discloses Scope 3 carbon emissions to the CDP in a given year, and zero otherwise	CDP
Emissions verification	This variable takes a value between zero and three, depending on the number of emission types (Scope 1, Scope 2, and Scope 3 emissions) for which a firm obtains external verification. Zero indicates that a firm either does not obtain any such verification or does not disclose carbon emissions at all. The variable takes the value of one or two if a firm obtains verification on one or two of the emissions types only and the value of three if a firm obtains verification on all three.	CDP
Total IO	Fraction of outstanding shares owned by institutional investors at the end of the fiscal year.	FactSet
High social norms IO	Fraction of outstanding shares owned by institutional investors from high social norm countries (as defined by Dyck et al. 2019) at the end of the fiscal year. An institutional investor's country is in the high social norms group if its Environmental Performance Index is higher than the median in a given year.	FactSet
Low social norms IO	Fraction of outstanding shares owned by institutional investors from low social norm countries (as defined by Dyck et al. 2019) at the end of the fiscal year. An institutional investor's country is in the low social norms group if its Environmental Performance Index is lower than the median in a given year.	FactSet
Total IO foreign	Fraction of outstanding shares owned by institutional investors from outside of a firm's country at the end of the fiscal year.	FactSet
Total IO local	Fraction of outstanding shares owned by institutional investors from a firm's country at the end of the fiscal year.	FactSet
High social norms IO foreign	Fraction of outstanding shares owned by institutional investors from outside of a firm's country that are located in high social norms countries. An institutional investor's country is in the high social norms group if its Environmental Performance Index is higher than the median in a given year.	FactSet
High social norms IO local	Fraction of outstanding shares owned by institutional investors from a firm's country that are located in high social norms countries. An institutional investor's country is in the high social norms group if its Environmental Performance Index is higher than the median in a given year.	FactSet
Low social norms IO foreign	Fraction of outstanding shares owned by institutional investors from outside of a firm's country that are located in low social norms countries. An institutional investor's country is in the low social norms group if its Environmental Performance Index is lower than the median in a given year.	FactSet
Low social norms IO local	Fraction of outstanding shares owned by institutional investors from a firm's country that are located in high social norms countries. An institutional investor's country is in the high social norms group if its Environmental Performance Index is lower than the median in a given year.	FactSet
Log(Assets)	The natural logarithm of total assets (Worldscope data item WC02999) at the end of the fiscal year. Winsorized at the 1% level.	Worldscope
Dividends/Net income	Dividends (Worldscope data item WC04551) at the end of the fiscal year, divided by net income/loss at the end of the fiscal year (Worldscope data item WC01706). Winsorized at the 1% level.	Worldscope
Debt/Assets	Sum of the book value of long-term debt (Worldscope data item WC03251) and the book value of current liabilities (WC03101) at the end of the fiscal year, divided by total assets at the end of the fiscal year (Worldscope data itemWC02999). Winsorized at the 1% level.	Worldscope

EBIT/Assets	Earnings before interest and taxes (Worldscope data item WC18191) at the end of the fiscal year, divided by total assets at the end of the fiscal year (Worldscope data item WC02999). Winsorized at the 1% level.	Worldscope
CapEx/Assets	Capital expenditures at the end of the fiscal year (Worldscope data item WC04601), divided by total assets at the end of the fiscal year (Worldscope data item WC02999). Winsorized at the 1% level.	Worldscope
Book-to-market	Difference between common equity (Worldscope data item WC03501) and preferred stock capital (WC03451) at the end of the fiscal year, divided by the equity market value (MV) at the end of the fiscal year. Winsorized at the 1% level.	Worldscope

Figure 1: Importance of Climate Risk Disclosure

This figure illustrates how important investors consider reporting by portfolio firms on climate risks compared to reporting on financial information (Question B1). Of the 439 individuals that participated in our survey, 416 responded to this question.

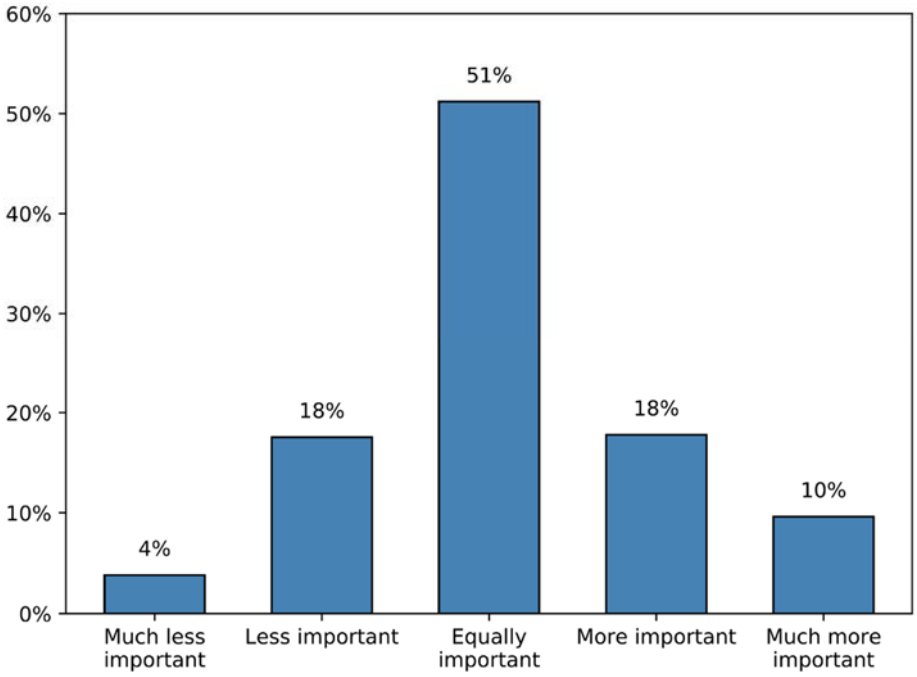


Figure 2: Engagement of Portfolio Firms to Report According to the TCFD Recommendations

This figure reports information about whether the investors engage or plan to engage their portfolio firms to report according to the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) (Question E5). Of the 439 individuals that participated in our survey, 304 responded to this question.

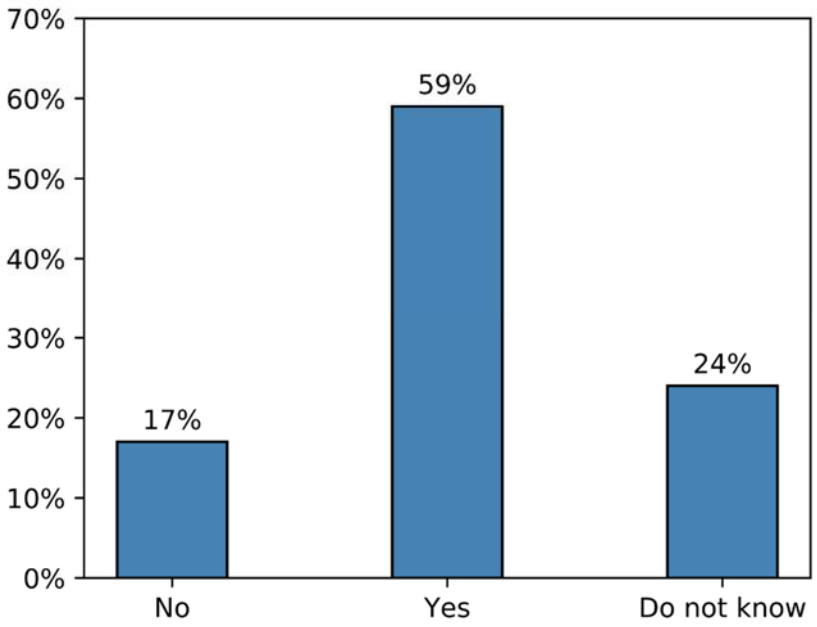


Figure 3: Carbon Footprint Disclosure by Investors

This figure reports information about whether the investors disclose or plan to disclose the carbon footprint of their portfolios (Question B2). Of the 439 individuals that participated in our survey, 327 responded to this question.

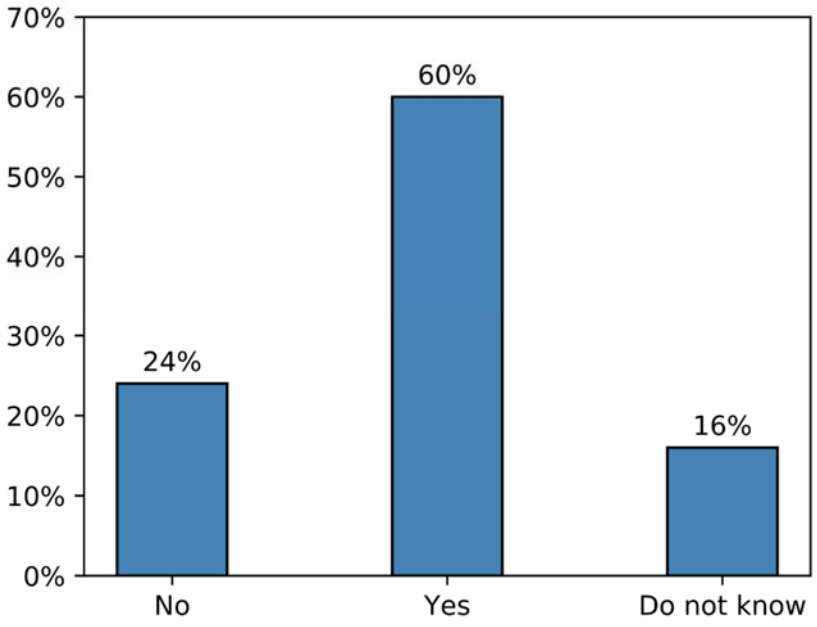


Figure 4: Climate Risk Mispricing across Sectors

This figure reports investors' beliefs about whether current equity valuations in specified sectors correctly reflect the risks and opportunities related to climate change (Question D1). Responses for each sector could vary between plus two (valuations much too high) and minus two (valuations much too low). The figure reports the mean response scores per sector. Of the 439 individuals that participated in our survey, 357 responded to this question.

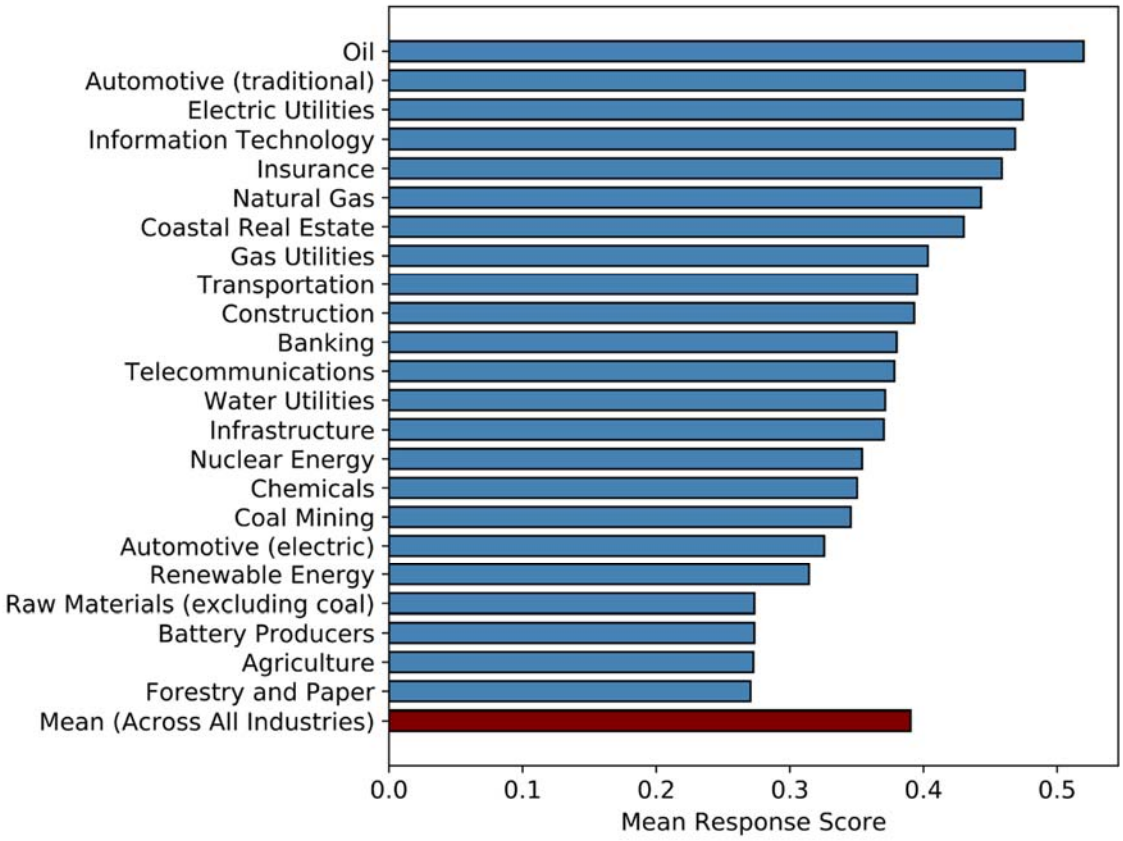


Table 1: Survey Respondent Characteristics

This table provides summary statistics on the characteristics of the 439 individuals that participated in our survey. As not all respondents provided information on all characteristics, we report the number of observations for different parts of the table. We report data on the distribution channel, position of the responding individuals (Question G8), type of institution they work for (Question G1), institution size (Question G6), investment horizon (Question G2), geographic distribution (Question G7). We also report the following percentages of the institution's portfolio: ESG share of portfolio (Question G5), equity and fixed-income share of portfolio (Question G3), and passive share of portfolio (Question G4). Detailed variable definitions are in the Data Appendix.

Distribution channels (N=439)	Percentage
Panel	73
Conferences	16
Asset owner	6
Personal	4
Respondent position (N=428)	**Percentage**
Fund/Portfolio manager	21
Executive/Managing director	18
Investment analyst/strategist	16
CIO	11
CEO	10
CFO/COO/Chairman/Other executive	10
ESG/RI specialist	10
Other	2
Institutional investor type (N=439)	**Percentage**
Asset manager	23
Bank	22
Pension fund	17
Insurance company	15
Mutual fund	8
Other institution	15
Assets under management (N=430)	**Percentage**
Less than $1bn	19
Between $1bn and $20bn	32
Between $20bn and $50bn	23
Between $50bn and $100bn	16
More than $100bn	11

Investor horizon (N=432)	Percentage
Short (less than 6 months)	5
Medium (6 months to 2 years)	38
Long (2 years to 5 years)	38
Very long (more than 5 years)	18
Region (N=429)	**Percentage**
United States	32
United Kingdom	17
Canada	12
Germany	11
Italy	7
Spain	5
The Netherlands	4
France	3
Others (<3%)	9
Investment structure	**Mean**
ESG share of portfolio (N=415)	40.6%
Equity share of portfolio (N=400)	47.0%
Fixed-income share of portfolio (N=402)	43.1%
Passive share of portfolio (N=419)	38.2%

Table 2: Importance of Climate Risk Disclosure

This table reports ordered logit regressions explaining the perceived importance of climate risk disclosure (relative to financial disclosure) (Question B1). The dependent variable, *Importance of climate risk disclosure,* measures how important investors consider reporting by portfolio firms on climate risks compared to reporting on financial information. The variable ranges between one and five, with one indicating that climate risk reporting is "much less important" and five indicating that it is "much more important". We use the following independent variables: *Climate risk ranking* is the ranking of the importance of climate risks relative to other risks. The variable ranges from one (most important risk) to six (least important risk). *Regulatory, physical, and technological climate risk* measure the financial materiality of regulatory climate risk, physical climate risk and technological climate risk (Question A2). All three variables can range between one (not at all important) and five (very important). *Temperature rise expectation* measures investors' expectations about the global temperature increase by the end of this century (Question E1). This variable can vary between one (no expectation of a temperature rise) and five (more than 3°C expected). The investor characteristics include: *Medium-term horizon; Long-term horizon*; *Assets under management*; *ESG share of portfolio; Passive share of portfolio; Independent institution;* and *HQ country social norms*. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the investor-country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Importance of climate risk disclosure				
	(1)	(2)	(3)	(4)	(5)
Climate risk ranking	-0.30***				
	(-4.37)				
Regulatory climate risk		0.30***			
		(4.05)			
Physical climate risk			0.71***		
			(6.58)		
Technological climate risk				0.53***	
				(6.57)	
Temperature rise expectation					0.34***
					(2.93)
Medium-term horizon	-0.22	-0.11	-0.2	-0.2	0.08
	(-0.52)	(-0.21)	(-0.33)	(-0.48)	(0.16)
Long-term horizon	-0.1	-0.14	-0.37	-0.22	-0.03
	(-0.20)	(-0.23)	(-0.50)	(-0.36)	(-0.05)
Assets under management	0.21***	0.23**	0.18*	0.23**	0.25**
	(2.70)	(2.41)	(1.93)	(2.52)	(2.43)
ESG share of portfolio (x100)	0.83	0.88*	0.66	0.7	0.98**
	(1.54)	(1.80)	(1.56)	(1.56)	(2.37)
Passive share of portfolio (x100)	-0.01	0.07	-0.11	0.01	-0.22
	(-0.03)	(0.18)	(-0.24)	(0.03)	(-0.49)
Independent institution	-0.05	-0.15	-0.07	-0.19	0.01
	(-0.17)	(-0.62)	(-0.29)	(-0.81)	(0.04)
HQ country social norms	1.28	1.59	2.48***	2.12**	1.46
	(1.34)	(1.50)	(3.14)	(2.16)	(1.00)
Respondent Position FE	Yes	Yes	Yes	Yes	Yes
Distribution Channel FE	Yes	Yes	Yes	Yes	Yes
Obs.	361	370	370	370	326
Pseudo R^2	0.06	0.05	0.09	0.07	0.05

Table 3: Evaluations of Climate Risk Disclosure Practices

This table reports survey responses to questions on different aspects of climate risk disclosure practices currently in use (Question B3). Respondents were asked to indicate their agreement with different statements on a scale of one ("strongly disagree") through five ("strongly agree"). Column (1) presents the percentage of respondents indicating strong agreement with a statement. Column (2) reports the mean score, where higher values correspond to stronger agreement. Column (3) reports the number of respondents. Column (4) reports the results of a *t*-test of the null hypothesis that each mean score is equal to 3 (neither agree nor disagree). *** indicates statistical significance at the 1% levels. Column (5) reports the results of a *t*-test of the null hypothesis that the mean score for a given reason is equal to the mean score for each of the other reasons, where significant differences at the 10% level are reported.

	Views on climate risk disclosure	% with 5 ("strongly agree") score (1)	Mean score (2)	N (3)	H_0: Mean score = 3 (4)	Significant differences in mean score vs. rows (5)
(1)	Management discussions on climate risk are not sufficiently precise	20.8%	3.78	413	***	1-4, 7
(2)	Firm-level quantitative information on climate risk is not sufficiently precise	19.4%	3.77	413	***	1-4
(3)	Standardized and mandatory reporting on climate risk is necessary	26.9%	3.91	413	***	4-7
(4)	There should be more standardization across markets in climate-related financial disclosure	27.4%	3.92	412	***	4-7
(5)	Standardized disclosure tools and guidelines are currently not available	21.3%	3.64	413	***	1-3, 5-6
(6)	Mandatory disclosure forms are not sufficiently informative regarding climate risk	17.8%	3.70	411	***	1-3, 5
(7)	Investors should demand that portfolio firms disclose their exposure to climate risk	27.6%	3.90	413	***	4-7

Table 4: Explaining Views on Climate Risk Disclosure Practices

This table reports the results of logit regressions explaining investors' views on climate risk disclosure practices currently in use (Question B3). We use seven dependent variables that reflect the respondents' agreements with different statements on climate risk disclosure on a scale of one ("strongly agree") through five ("strongly disagree"). The four dependent variables are dummy variables that equal one if a respondent indicated "strong agreement" with a statement on the current disclosure practice, and zero otherwise. We use the following independent variables: *Climate risk financial materiality* (larger numbers reflect greater perceived importance); *Medium-term horizon; Long-term horizon*; *Assets under management*; *ESG share of portfolio; Passive share of portfolio; Independent institution;* and *HQ country social norms*. Detailed variable definitions are in the Data Appendix. We report marginal effects of the logit estimates. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the investor-country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Management discussions imprecise	*Quantitative information imprecise*	*Stand. and mandatory reporting necessary*	*More stand-ardization across markets*	*Stand-ardized tools not available*	*Disclosure forms not sufficiently informative*	*Demand more disclosure*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Climate risk financial materiality	0.09**	0.06**	0.10***	0.14***	0.08**	0.06**	0.15***
	(2.42)	(2.46)	(4.06)	(4.38)	(2.00)	(2.47)	(3.99)
Medium-term horizon	0.11	-0.05	0.12	0.03	0.08	-0.07	-0.11
	(0.91)	(-0.46)	(0.78)	(0.15)	(0.83)	(-0.84)	(-0.73)
Long-term horizon	0.14	0.02	0.14	0.03	0.08	-0.08	-0.17
	(1.19)	(0.16)	(0.99)	(0.34)	(1.02)	(-0.88)	(-1.24)
Assets under management	0.01	0.00	-0.02	-0.01	0.03*	0.02***	-0.01
	(1.16)	(0.16)	(-1.41)	(-0.85)	(1.77)	(3.87)	(-0.94)
ESG share of portfolio (x100)	0.22***	0.14**	0.27***	0.08	0.17**	0.14***	0.05
	(3.31)	(2.06)	(3.22)	(0.94)	(2.18)	(2.83)	(0.52)
Passive share of portfolio (x100)	-0.06	0.06	0.12	-0.00	0.09	-0.08	0.14
	(-0.71)	(1.03)	(1.02)	(-0.01)	(1.29)	(-0.95)	(1.26)
Independent institution	0.04	0.01	-0.05	-0.08	0.08**	0.04	-0.02
	(0.51)	(0.35)	(-1.60)	(-1.29)	(2.24)	(1.29)	(-1.04)
HQ country social norms	0.33	-0.19	-0.03	-0.14	0.08	0.04	0.01
	(1.28)	(-0.82)	(-0.12)	(-0.54)	(0.31)	(0.20)	(0.04)
Respondent Position FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distribution Channel FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	369	369	369	369	369	369	369
Pseudo R^2	0.13	0.09	0.11	0.11	0.10	0.11	0.15

Table 5: Recent Initiatives in Climate Risk Disclosure

This table reports the results of logit regressions explaining recent initiatives in climate risk disclosure. We use two dependent variables. *TCFD engagement* equals one if a respondent engages or plans to engage portfolio firms to report according to the recommendations of the Task Force on Climate-related Financial Disclosures (Question E5), and zero otherwise. *Carbon footprint* equals one if a respondent discloses or plans to disclose the overall carbon footprint of their portfolio, and zero otherwise (Question B2). We use the following independent variables: *Climate risk financial materiality; Medium-term horizon; Long-term horizon*; *Assets under management*; *ESG share of portfolio; Passive share of portfolio; Independent institution;* and *HQ country social norms*. Detailed variable definitions are in the Data Appendix. We report marginal effects of the logit estimates. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the investor-country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	TCFD engagement	*Carbon footprint*
	(1)	(2)
Climate risk financial materiality	0.04*	0.06***
	(1.71)	(3.92)
Medium-term horizon	-0.03	-0.14**
	(-0.45)	(-1.97)
Long-term horizon	-0.04	-0.20*
	(-0.62)	(-1.84)
Assets under management	0.01	0.05*
	(0.23)	(1.78)
ESG share of portfolio (x100)	0.38***	0.21***
	(3.33)	(2.67)
Passive share of portfolio (x100)	0.04	0.19
	(0.45)	(0.97)
Independent institution	-0.01	0.06
	(-0.35)	(1.14)
HQ country social norms	1.09***	0.12
	(5.40)	(0.36)
Respondent Position FE	Yes	Yes
Distribution Channel FE	Yes	Yes
Obs.	275	306
Pseudo R^2	0.11	0.07

Table 6: Recent Disclosure Initiatives and Assessment of Climate Risk Disclosure

This table reports the results of logit regressions explaining investors' views on current climate risk disclosure practices (Question B3). We use four dependent variables that reflect the respondents' agreement with different statements on a scale of one ("strongly agree") through five ("strongly disagree"). The four dependent variables are dummy variables that equal one if a respondent indicated "strong agreement" with a statement on the current disclosure practice, and zero otherwise. We use the following independent variables: *TCFD engagement* is a dummy variable equal to one if respondents engage or plan to engage portfolio firms to report according to the recommendations of the Task Force on Climate related Financial Disclosures (Question E5). *Carbon footprint* is a dummy variable equal to one if respondents disclose or plan to disclose the overall carbon footprint of their portfolio, and zero otherwise (Question B2). The following independent variables are also included: *Medium-term horizon; Long-term horizon*; *Assets under management*; *ESG share of portfolio; Passive share of portfolio; Independent institution;* and *HQ country social norms*. Detailed variable definitions are in the Data Appendix. We report marginal effects of the logit estimates. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the investor-country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Demand more disclosure		*Quantitative information imprecise*		*Management discussions imprecise*		*Standardized and mandatory reporting necessary*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TCFD	0.18**		0.08		0.13*		0.20***	
	(2.24)		(1.29)		(1.66)		(3.10)	
Carbon footprint		0.23**		0.06		0.07*		0.11*
		(2.32)		(1.07)		(1.68)		(1.93)
Medium horizon	-0.08	-0.07	-0.03	-0.09	0.12	0.11	0.16	0.14
	(-0.50)	(-0.49)	(-0.23)	(-0.73)	(0.83)	(0.75)	(0.97)	(0.89)
Long horizon	-0.08	-0.02	0.05	0.02	0.23	0.22	0.26	0.26
	(-0.49)	(-0.17)	(0.33)	(0.13)	(1.61)	(1.49)	(1.38)	(1.58)
Assets under management	-0.01	-0.02	-0.01	-0.00	0.00	0.01	-0.05**	-0.04**
	(-0.69)	(-1.20)	(-0.77)	(-0.08)	(0.14)	(1.17)	(-2.56)	(-2.14)
ESG share (x100)	0.18*	0.09	0.12	0.12*	0.29***	0.26***	0.25***	0.27***
	(1.92)	(0.86)	(1.49)	(1.96)	(3.24)	(4.55)	(3.05)	(3.29)
Passive share (x100)	0.10	0.13	0.05	0.15**	-0.03	-0.01	0.08	0.20*
	(0.65)	(0.73)	(0.78)	(2.24)	(-0.31)	(-0.09)	(0.59)	(1.87)
Independent institution	-0.02	-0.02	-0.02	0.02	0.05	0.04	-0.05	-0.05
	(-0.58)	(-0.58)	(-0.37)	(0.66)	(0.59)	(0.54)	(-1.36)	(-1.04)
HQ country social norms	-0.40	-0.31	-0.44*	-0.39	0.10	0.23	-0.31	-0.25
	(-1.49)	(-0.66)	(-1.81)	(-1.59)	(0.19)	(0.51)	(-1.16)	(-0.71)
Respondent Position FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distribution Channel FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	292	305	292	309	292	305	292	309
Pseudo R^2	0.12	0.10	0.06	0.08	0.11	0.08	0.09	0.09

Table 7: Climate Risk Disclosure and Climate Risk Mispricing

This table reports the results of OLS regressions explaining perceptions of climate risk mispricing (Question D1). We use two dependent variables to capture the respondents' views on the mispricing of climate risks: *Climate risk underpricing* averages positive mispricing scores across all specified sectors (negative scores are set to zero). The variable ranges between plus two (strong average overvaluation) and zero (no average overvaluation). *Climate risk mispricing* averages the absolute values of all mispricing scores across all specified sectors. We use the following independent variables: *Demand more disclosure* equals one if a respondent indicated strong agreement to the statement that investors should demand that portfolio firms disclose their exposure to climate risk, and zero otherwise (Question B3). *Quantitative information imprecise* equals one if a respondent indicated strong agreement to the statement that firm-level quantitative information on climate risk is not sufficiently precise, and zero otherwise (Question B3). *Quantitative information imprecise* equals one if a respondent indicated strong agreement to the statement that management discussions on climate risk are not sufficiently precise, and zero otherwise (Question B3). We additionally control for: *Climate risk financial materiality* (larger numbers reflect greater perceived importance); *Medium-term horizon; Long-term horizon*; *Assets under management*; *ESG share of the portfolio; Passive share of the portfolio; Independent institution;* and *HQ country social norms*. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the investor-country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Climate risk underpricing			*Climate risk mispricing*		
	(1)	(2)	(3)	(4)	(5)	(6)
Demand more disclosure	0.20***			0.16***		
	(4.29)			(3.28)		
Quantitative information imprecise		0.24**			0.24***	
		(2.84)			(4.79)	
Management discussions imprecise			0.22***			0.19***
			(3.53)			(3.98)
Climate risk financial materiality	-0.01	-0.01	-0.01	0.02	0.02	0.02
	(-0.43)	(-0.14)	(-0.16)	(0.73)	(0.64)	(0.70)
Medium-term horizon	-0.03	-0.04	-0.07	0.01	0.01	-0.02
	(-0.27)	(-0.30)	(-0.54)	(0.12)	(0.06)	(-0.15)
Long-term horizon	-0.00	-0.04	-0.06	0.03	-0.01	-0.02
	(-0.04)	(-0.39)	(-0.54)	(0.28)	(-0.05)	(-0.18)
Assets under management	0.03	0.03	0.03	0.00	0.00	-0.00
	(1.59)	(1.34)	(1.36)	(0.06)	(0.00)	(-0.17)
ESG share of portfolio (x100)	0.29***	0.28***	0.26**	0.19***	0.18**	0.16*
	(3.60)	(3.09)	(2.48)	(3.01)	(2.52)	(2.03)
Passive share of portfolio (x100)	-0.02	-0.00	0.01	-0.05	-0.03	-0.02
	(-0.21)	(-0.05)	(0.08)	(-0.49)	(-0.34)	(-0.18)
Independent institution	-0.03	-0.04	-0.05	-0.03	-0.04	-0.04
	(-0.47)	(-0.58)	(-0.82)	(-0.49)	(-0.59)	(-0.82)
HQ country social norms	-0.20	-0.16*	-0.29*	-0.30*	-0.26	-0.37**
	(-1.63)	(-1.82)	(-2.10)	(-2.11)	(-1.68)	(-2.25)
Respondent Position FE	Yes	Yes	Yes	Yes	Yes	Yes
Distribution Channel FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	343	343	343	343	343	343
Adjusted R^2	0.06	0.07	0.06	0.03	0.05	0.03

Table 8: Carbon Emissions Disclosure and Institutional Ownership

This table reports the results of OLS regressions explaining a firm's propensity to disclose Scope 1 carbon emissions to the CDP. The dependent variable, *Scope 1 disclosure,* equals one if a firm discloses Scope 1 carbon emissions to the CDP in a given year, and zero otherwise. We use the following independent variables: *Total IO* measures the fraction of a firm's equity owned by institutional investors. *High social norms IO* and *Low social norms IO* are components of *Total IO* and measure the fraction of a firm's equity that is owned by institutional investors from high and low social norms countries, respectively. We measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI) obtained from Yale Center of Environmental Law and Center for international Earth Science Information Network. We define a country to be in the high social norms group if its EPI is higher than the median in that year, and in the low social norms group otherwise. The following independent variables are also included: *Log(Assets); Dividends/Net income*; *Debt/Assets*; *EBIT/Assets*; *CapEx/Assets*; and *Book-to-market*. The sample includes all firms contacted by the CDP and the sample period covers the years 2009 to 2017. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Scope 1 disclosure			
	(1)	(2)	(3)	(4)
Total IO	0.16**		0.17**	
	(2.10)		(2.35)	
High social norms IO		0.35***		0.30***
		(3.91)		(3.86)
Low social norms IO		-0.03		0.03
		(-0.68)		(0.70)
Log(Assets)	0.07***	0.07***	0.06***	0.07***
	(6.31)	(8.03)	(5.73)	(6.76)
Dividends/Net income	0.02***	0.02***	0.02***	0.02***
	(3.64)	(3.05)	(3.92)	(3.55)
Debt/Assets	-0.04*	-0.06**	0.01	-0.00
	(-1.92)	(-2.50)	(0.59)	(-0.10)
EBIT/Assets	-0.14***	-0.10**	-0.06	-0.05
	(-3.65)	(-2.41)	(-1.46)	(-1.20)
CapEx/Assets	-0.02	0.01	-0.09	-0.09
	(-0.14)	(0.06)	(-0.75)	(-0.75)
Book-to-market	-0.06***	-0.06***	-0.04***	-0.04***
	(-4.25)	(-5.43)	(-3.84)	(-4.50)
Industry FE	No	No	Yes	Yes
Year FE	No	No	Yes	Yes
Industry-Year FE	No	No	Yes	Yes
Obs.	28,347	28,347	28,338	28,338
Adjusted R^2	0.14	0.16	0.21	0.22

Table 9: Carbon Emissions Verification and Institutional Ownership

This table reports the results of OLS regressions explaining whether firms obtain third party verification for emissions reported to the CDP. The dependent variable, *Emissions verification,* takes a value between zero and three, depending on the number of emission types (Scope 1, Scope 2, and Scope 3 emissions) for which a firm obtains external verification. Zero indicates that a firm either does not obtain any such verification or does not disclose carbon emissions at all. The variable takes the value of one or two if a firm obtains verification on one or two of the emissions types only and the value of three if a firm obtains verification on all three. We use the following independent variables: *Total IO* measures the fraction of a firm's equity owned by institutional investors. *High social norms IO* and *Low social norms IO* are components of *Total IO* and measure the fraction of a firm's equity owned by institutional investors in high social norms countries and low social norms countries, respectively. We measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI) obtained from the Yale Center of Environmental Law and Center for international Earth Science Information Network. We define a country to be in the high social norms group if its EPI is higher than the median in that year, and in the low social norms group otherwise. The following independent variables are also included: *Log(Assets); Dividends/Net income*; *Debt/Assets*; *EBIT/Assets*; *CapEx/Assets*; and *Book-to-market*. The sample includes all firms contacted by the CDP and the sample period covers the years 2009 to 2017. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Emissions verification			
	(1)	(2)	(3)	(4)
Total IO	0.12		0.13	
	(0.68)		(0.83)	
High social norms IO		0.53**		0.40**
		(2.68)		(2.24)
Low social norms IO		-0.30***		-0.14
		(-3.53)		(-1.40)
Log(Assets)	0.17***	0.18***	0.16***	0.17***
	(6.53)	(8.48)	(5.88)	(6.98)
Dividends/Net income	0.04***	0.03***	0.04***	0.04***
	(3.60)	(2.91)	(3.48)	(3.12)
Debt/Assets	-0.07	-0.11*	0.03	-0.00
	(-1.36)	(-2.02)	(0.48)	(-0.07)
EBIT/Assets	-0.29***	-0.20	-0.17	-0.15
	(-2.74)	(-1.61)	(-1.66)	(-1.42)
CapEx/Assets	-0.33	-0.27	-0.31	-0.31
	(-1.05)	(-0.88)	(-0.93)	(-0.94)
Book-to-market	-0.15***	-0.15***	-0.10***	-0.11***
	(-4.66)	(-5.89)	(-4.51)	(-5.21)
Industry FE	No	No	Yes	Yes
Year FE	No	No	Yes	Yes
Industry-Year FE	No	No	Yes	Yes
Obs.	28,347	28,347	28,338	28,338
Adjusted R^2	0.13	0.15	0.19	0.19

Table 10: Carbon Emissions Disclosure and Institutional Ownership: Foreign versus Local Ownership

This table reports the results of OLS regressions explaining a firm's propensity to disclose Scope 1 carbon emissions to the CDP. The dependent variable, *Scope 1 disclosure,* equals one if a firm discloses Scope 1 carbon emissions to the CDP in a given year, and zero otherwise. We use the following independent variables: *Total IO foreign* measures the fraction of a firm's equity owned by institutional investors outside of a firm's country. *Total IO local* measures the fraction of a firm's equity owned by institutional investors from a firm's country. *High social norms IO foreign* and *Low social norms IO foreign* measure the fraction of a firm's equity owned by institutional investors from outside of a firm's country that are located in high social norms countries and low social norms countries, respectively. *High social norms IO local* and *Low social norms IO local* are defined accordingly. We measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI) obtained from Yale Center of Environmental Law and Center for international Earth Science Information Network. We define a country to be in the high social norms group if its EPI is higher than the median in that year, and in the low social norms group otherwise. The following independent variables are also included (not reported): *Log(Assets); Dividends/Net income*; *Debt/Assets*; *EBIT/Assets*; *CapEx/Assets*; and *Book-to-market*. The sample includes all firms contacted by the CDP and the sample period covers the years 2009 to 2017. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Scope 1 disclosure					
	(1)	(2)	(3)	(4)	(5)	(6)
Total IO foreign	0.33***		0.28***		0.19**	
	(3.22)		(2.87)		(2.62)	
Total IO local	0.12		0.14*		0.02	
	(1.56)		(1.94)		(0.13)	
High social norms IO foreign		0.56***		0.42***		0.46***
		(4.58)		(3.89)		(4.57)
High social norms IO local		0.29***		0.27***		0.07
		(3.77)		(3.80)		(0.68)
Low social norms IO foreign		-0.06		0.05		-0.18**
		(-1.04)		(0.70)		(-2.21)
Low social norms IO local		-0.02		0.02		-0.17**
		(-0.56)		(0.51)		(-2.40)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Year FE	No	No	Yes	Yes	No	No
Industry-Year FE	No	No	Yes	Yes	No	No
Country FE	No	No	No	No	Yes	Yes
Obs.	23,942	28,347	23,924	28,338	23,942	28,347
Adjusted R^2	0.14	0.16	0.22	0.22	0.19	0.21

Table 11: Carbon Emissions Verification and Institutional Ownership: Foreign versus Local Ownership

This table reports the results of OLS regressions explaining whether firms obtain third party verification for carbon emissions reported to the CDP. The dependent variable, *Emissions verification,* takes a value between zero and three, depending on the number of emission types (Scope 1, Scope 2, and Scope 3 emissions) for which a firm obtains external verification. Zero indicates that a firm either does not obtain any such verification or does not disclose carbon emissions at all. The variable takes the value of one or two if a firm obtains verification on one or two of the emissions types only and the value of three if a firm obtains verification on all three. We use the following dependent variables: *Total IO foreign* measures the fraction of a firm's equity owned by institutional investors outside of a firm's country. *Total IO local* measures the fraction of a firm's equity owned by institutional investors from a firm's country. *High social norms IO foreign* and *Low social norms IO foreign* and measure the fraction of a firm's equity owned by institutional investors from outside of a firm's country that are located in high social norms countries and low social norms countries, respectively. *High social norms IO local* and *Low social norms IO local* are defined accordingly. Following Dyck et al. (2019), we measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI) obtained from the Yale Center of Environmental Law and Center for international Earth Science Information Network. We define a country to be in the high social norms group if its EPI is higher than the median in that year, and in the low social norms group otherwise. The following independent variables are also included (not reported): *Log(Assets); Dividends/Net income*; *Debt/Assets*; *EBIT/Assets*; *CapEx/Assets*; and *Book-to-market*. The sample includes all firms contacted by the CDP and the sample period covers the years 2009 to 2017. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

	Emissions verification					
	(1)	(2)	(3)	(4)	(5)	(6)
Total IO foreign	0.51**		0.42*		0.21	
	(2.16)		(1.90)		(1.08)	
Total IO local	0.01		0.06		-0.04	
	(0.07)		(0.40)		(-0.17)	
High social norms IO foreign		1.10***		0.76***		0.87***
		(3.62)		(2.90)		(3.23)
High social norms IO local		0.37**		0.31**		0.05
		(2.50)		(2.10)		(0.25)
Low social norms IO foreign		-0.40***		-0.08		-0.63***
		(-3.94)		(-0.70)		(-3.81)
Low social norms IO local		-0.29***		-0.17*		-0.44**
		(-3.35)		(-1.76)		(-2.36)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Year FE	No	No	Yes	Yes	No	No
Industry-Year FE	No	No	Yes	Yes	No	No
Country FE	No	No	No	No	Yes	Yes
Obs.	23,942	28,347	23,924	28,338	23,942	28,347
Adjusted R^2	0.14	0.16	0.20	0.19	0.19	0.21

Internet Appendix

for

Climate Risk Disclosure and Institutional Investors

Internet Appendix A: Survey Instrument

Survey on Climate Risk

We are a team of professors from [XXX], [XXX], and [XXX].

This survey seeks a better understanding of whether and how institutional investors incorporate **climate risk** when making investment decisions. The survey will take about **10 minutes**.

You can use this survey questionnaire or take the survey online at: [LINK]

We take the **confidentiality** of your responses very seriously. We **will not share your responses** with anyone, nor will individual firms or respondents be identified. Only aggregate data will be made public. We will not link the survey responses to any other data.

Thank you for participating in this survey. If you have any questions, please contact us.

[XXX], [XXX], and [XXX]

GENERAL INFORMATION

G1: How is the institution at which you work best described?

- □ Public pension fund
- □ Insurance company
- □ Mutual fund management company
- □ Asset manager (for pension funds, endowments, etc.)
- □ Sovereign wealth fund
- □ Other (please specify): _____
- □ Private pension fund
- □ Hedge fund
- □ Private equity fund
- □ Endowment, charity
- □ Bank

G2: What is the typical holding period for investments in your portfolio, on average?

- □ Short (less than 6 months)
- □ Medium (6 months to 2 years)
- □ Long (2 years to 5 years)
- □ Very long (more than 5 years)

G3: What percentage of your portfolio is invested in fixed income versus equity securities?

___ % in fixed income

___ % in equities

G4: What percentage of your portfolio is invested actively versus passively?

___ % in active investments

___ % in passive investments

G5: What percentage of your portfolio incorporates Environmental, Social and Governance (ESG) issues? ____ %

G6: What is the total size of assets under management for your institution?

- □ Less than $1 billion
- □ Between $1 billion and $20 billion
- □ Between $20 billion and $50 billion
- □ Between $50 billion and $100 billion
- □ More than $100 billion

G7: In which country are your institution's headquarters based? _____

G8: What is your position?

- □ Fund/Portfolio Manager
- □ Investment Analyst/Strategist
- □ Chief Investment Officer
- □ CFO/COO/Chairman/Other Executive
- □ Chief Executive Officer
- □ Executive/Managing Director
- □ ESG/Responsible Investment Specialist
- □ Other (please explain): _____

PART A: IMPORTANCE OF CLIMATE RISK

A1: Please rank the following six <u>risks</u> when making investments in portfolio firms from 1 to 6, where 1 is the most important to you and 6 the least important.

Financial risk (earnings, leverage, payout policy, etc.)	
Operating risk (changes in demand, input costs, etc.)	
Governance risk (board structure, executive pay, etc.)	
Social risk (labor standards, human rights, etc.)	
Climate risk	
Other environmental risk (pollution, recycling, etc.)	

A2: We have divided climate risk into *regulatory risks* (changes in regulation), *physical risks* (changes in the physical climate), and *technological risks* (climate-related technological disruption). Please rate the financial materiality of these risks.

	Not at all important	Slightly important	Important	Fairly important	Very important
Regulatory risks	□	□	□	□	□
Physical risks	□	□	□	□	□
Technological risks	□	□	□	□	□

A3 to A5: [NOT COVERED IN THIS PAPER]

PART B: DISCLOSURE ON CLIMATE RISK

B1: How important do you consider reporting by portfolio firms on climate risk compared to reporting on financial information?

Much less important	Less important	Equally important	More important	Much more important
□	□	□	□	□

B2: Do you disclose (or plan to disclose) the overall carbon footprint of your portfolio?

□ No □ Yes □ Do not know

B3: To what extent do you agree with the following statements regarding climate-risk disclosure by portfolio firms?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
• Investors should demand that portfolio firms disclose their exposure to climate risk	□	□	□	□	□
• Firm-level quantitative information on climate risk is not sufficiently precise	□	□	□	□	□
• Management discussions on climate risk are not sufficiently precise	□	□	□	□	□
• Standardized and mandatory reporting on climate risk is necessary	□	□	□	□	□
• Mandatory disclosure forms are not sufficiently informative regarding climate risk	□	□	□	□	□
• There should be more standardization across markets in climate-related financial disclosure	□	□	□	□	□
• Standardized disclosure tools and guidelines are currently not available	□	□	□	□	□

PART C: CLIMATE RISK MANAGEMENT & ENGAGEMENT

[NOT COVERED IN THIS PAPER]

PART D: PRICING OF CLIMATE RISK

D1: To what extent do equity valuations of firms in different industries reflect the risks and opportunities related to climate change?

Industry	Valuations much too high	Valuations somewhat too high	Valuations more or less correct	Valuations somewhat too low	Valuations much too low
Oil	□	□	□	□	□
Natural gas	□	□	□	□	□
Renewable energy	□	□	□	□	□
Nuclear energy	□	□	□	□	□
Electric utilities	□	□	□	□	□
Gas utilities	□	□	□	□	□
Water utilities	□	□	□	□	□
Coal mining	□	□	□	□	□
Raw materials (excluding coal)	□	□	□	□	□
Infrastructure	□	□	□	□	□
Chemicals	□	□	□	□	□
Automotive (traditional)	□	□	□	□	□
Automotive (electric)	□	□	□	□	□
Battery producers	□	□	□	□	□
Construction	□	□	□	□	□
Banking	□	□	□	□	□
Insurance	□	□	□	□	□
Agriculture	□	□	□	□	□
Forestry and paper	□	□	□	□	□
Information Technology	□	□	□	□	□
Telecommunications	□	□	□	□	□
Transportation	□	□	□	□	□
Coastal real estate	□	□	□	□	□

D2 to D4: [NOT COVERED IN THIS PAPER]

PART E: ADDITIONAL INFORMATION

E1: The *Paris Climate Accord* aims to keep the global temperature rise "well below 2 degrees Celsius" above pre-industrial levels by the end of this century. What are your expectations for the global temperature rise by the end of this century?

Increase in global temperature by:					
None	Up to 1 degree	Up to 2 degrees	Up to 3 degrees	More than 3 degrees	Do not know
□	□	□	□	□	□

E2 to E4: [NOT COVERED IN THIS PAPER]

E5: Do you engage (or plan to engage) portfolio companies to report according to the recommendations of the Task Force on Climate related Financial Disclosures (TCFD)?

□ No □ Yes □ Do not know

Internet Appendix B: Additional Tables

Internet Appendix Table 1: Summary Statistics

Panel A provides summary statistics of the survey-based variables that we use in the Tables 1 through 7. The data are based on the responses of 439 individuals that participated in our survey. As not all respondents provided answers to all questions, the number of observations for a given variable are reported for each question. Panel B provides summary statistics for the archival variables in Table 8 through 11, as well as Internet Appendix Table 2. The sample period covers the years 2009 to 2017. More detailed variable definitions are in the Data Appendix.

Panel A: Survey-Based Variables

Variable	Mean	STD	Median	Obs.	Survey question
Measures of risk importance					
Importance of climate risk disclosure	3.1	0.9	3.0	416	B1
Climate risk ranking	4.0	1.6	4.0	386	A1
Regulatory climate risk	3.8	1.0	4.0	393	A2
Physical climate risk	3.5	1.1	4.0	393	A2
Technological climate risk	3.8	1.0	4.0	393	A2
Temperature rise expectation	3.3	1.0	3.0	342	E1
Climate risk financial materiality	3.7	0.8	3.7	393	A2
Agreements on statements regarding disclosure					
Demand more disclosure	0.3	0.4	0.0	413	B3
Quantitative information imprecise	0.2	0.4	0.0	413	B3
Management discussions imprecise	0.2	0.4	0.0	413	B3
Standardized and mandatory reporting necessary	0.3	0.4	0.0	413	B3
Disclosure forms not sufficiently informative	0.2	0.4	0.0	411	B3
More standardization across markets	0.3	0.4	0.0	412	B3
Standardized tools not available	0.2	0.4	0.0	413	B3
Other variables					
Climate risk underpricing	0.6	0.4	0.5	357	D1
Climate risk mispricing	0.8	0.4	0.7	357	D1
Carbon footprint	0.7	0.5	1.0	327	B2
TCFD engagement	0.8	0.4	1.0	304	E5
Medium-term horizon	0.8	0.4	1.0	432	G2
Long-term horizon	0.2	0.4	0.0	432	G2
Assets under management	2.7	1.3	2.0	430	G6
ESG share of portfolio	0.4	0.3	0.3	415	G5
Passive share of portfolio	0.4	0.2	0.4	419	G4
Independent institution	0.5	0.5	1.0	439	G1
HQ country social norms	0.6	0.1	0.6	425	G7

Panel B: Archival Variables

Variable	Mean	STD	Median	Obs.
Scope 1 disclosure	0.17			34,574
Scope 2 disclosure	0.16			34,574
Scope 3 disclosure	0.20			34,574
Emissions verification	0.34	0.88	0.00	34,574
Total IO	0.27	0.26	0.17	34,574
High social norms IO	0.16	0.20	0.08	34,574
Low social norms IO	0.11	0.20	0.04	34,574
Total IO foreign	0.12	0.13	0.09	33,362
Total IO local	0.17	0.24	0.06	30,379
High social norms IO foreign	0.07	0.09	0.04	34,574
High social norms IO local	0.09	0.18	0.00	34,574
Low social norms IO foreign	0.04	0.08	0.02	34,574
Low social norms IO local	0.07	0.19	0.00	34,574
Log(Assets)	15.00	2.05	14.96	34,574
Dividends/Net income	0.38	0.73	0.26	34,232
Debt/Assets	0.44	0.20	0.44	29,035
EBIT/Assets	0.07	0.10	0.06	33,888
CapEx/Assets	0.05	0.05	0.03	34,355
Book-to-market	0.74	0.58	0.60	34,538

Internet Appendix Table 2: Carbon Emissions and Scope 2 and Scope 3 Disclosure

This table reports the results of OLS regressions explaining a firm's propensity to disclose Scope 2 and Scope 3 carbon emissions to the CDP. We use two dependent variables: *Scope 2 disclosure* equals one if a firm discloses Scope 2 carbon emissions to the CDP in a given year, and zero otherwise. *Scope 3 disclosure* is defined accordingly but for Scope 3 carbon emissions. We use the following independent variables: *Total IO* measures the fraction of a firm's equity owned by institutional investors. *High social norms IO* and *Low social norms IO* are components of *Total IO* and measure the fraction of a firm's equity owned by institutional investors in high social norms countries and low social norms countries, respectively. We measure a country's social norms concerning environmental issues with the Environmental Performance Index (EPI) obtained from Yale Center of Environmental Law and Center for international Earth Science Information Network. We define a country to be in the high social norms group if its EPI is higher than the median in that year, and in the low social norms group otherwise. The following independent variables are also included: *Log(Assets); Dividends/Net income*; *Debt/Assets*; *EBIT/Assets*; *CapEx/Assets*; and *Book-to-market*. The sample includes all firms contacted by the CDP and the sample period covers the years 2009 to 2017. Detailed variable definitions are in the Data Appendix. The *t*-statistics (reported in parentheses) are based on standard errors clustered at the country level. ***, **, * indicate significance levels of 1%, 5%, and 10%, respectively.

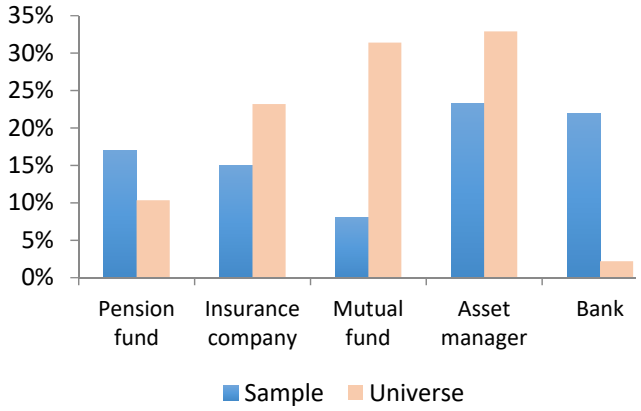
	Scope 2 disclosure				*Scope 3 disclosure*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total IO	0.16**		0.17**		0.14*		0.14*	
	(2.16)		(2.38)		(1.74)		(1.97)	
High social norms IO		0.34***		0.30***		0.32***		0.29***
		(3.97)		(3.96)		(3.58)		(3.59)
Low social norms IO		-0.02		0.03		-0.04		-0.00
		(-0.46)		(0.66)		(-1.40)		(-0.08)
Log(Assets)	0.06***	0.07***	0.06***	0.06***	0.08***	0.08***	0.07***	0.08***
	(5.96)	(7.42)	(5.42)	(6.39)	(9.69)	(13.77)	(8.91)	(11.89)
Dividends/Net income	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
	(3.82)	(3.21)	(4.13)	(3.73)	(4.14)	(3.58)	(4.18)	(3.85)
Debt/Assets	-0.03	-0.05*	0.02	0.01	-0.04*	-0.06**	0.02	0.00
	(-1.38)	(-1.97)	(0.93)	(0.25)	(-1.71)	(-2.58)	(0.84)	(0.12)
EBIT/Assets	-0.12***	-0.09*	-0.06	-0.04	-0.13***	-0.09**	-0.08**	-0.06*
	(-3.09)	(-1.99)	(-1.29)	(-1.02)	(-4.27)	(-2.71)	(-2.06)	(-1.74)
CapEx/Assets	-0.03	-0.00	-0.10	-0.10	-0.06	-0.03	-0.07	-0.07
	(-0.19)	(-0.00)	(-0.79)	(-0.79)	(-0.49)	(-0.27)	(-0.56)	(-0.56)
Book-to-market	-0.06***	-0.05***	-0.04***	-0.04***	-0.06***	-0.06***	-0.04***	-0.04***
	(-4.19)	(-5.23)	(-3.83)	(-4.45)	(-4.93)	(-6.10)	(-4.07)	(-4.63)
Constant	-0.76***	-0.82***	-0.76***	-0.80***	-0.91***	-0.97***	-0.92***	-0.97***
	(-6.08)	(-8.15)	(-5.41)	(-6.68)	(-8.78)	(-13.05)	(-7.81)	(-10.78)
Industry FE	No	No	Yes	Yes	No	No	Yes	Yes
Year FE	No	No	Yes	Yes	No	No	Yes	Yes
Industry-Year FE	No	No	Yes	Yes	No	No	Yes	Yes
Obs.	28,347	28,347	28,338	28,338	28,347	28,347	28,338	28,338
Adjusted R^2	0.13	0.15	0.20	0.21	0.15	0.17	0.24	0.24

Internet Appendix C: Additional Figures

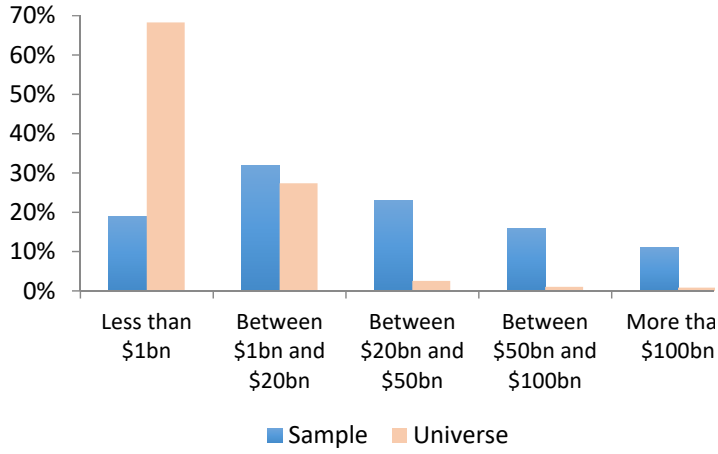
Internet Appendix Figure 1
Comparison of sample characteristics with universe of institutional investors

These figures compare key characteristics of the institutional investors in our sample with those of the universe of institutional investors as defined by the FactSet Standard Entity database. Summary statistics of the sample are identical to the statistics reported in Table 1. In Internet Appendix Figure 1A we use the FactSet item "entity_sub_type" to identify institutional investor types. Pension fund, Insurance and Mutual Fund correspond to "Pension fund manager", "Insurance Company", and "Mutual fund manager" entity structures, respectively. Bank corresponds to "Bank investment division" and "Investment banking". Asset manager includes "Fund of funds manager", "Fund of hedge funds manager", "Private banking/Wealth Management", "Real estate manager", "Family office" and "Investment Company entities". In Internet Appendix Figure 1B assets under management measure the market value of a given fund portfolio. We use the Ownership (LionShares) - Unadjusted Fund Holdings Historical database to compute the market value of each fund portfolio. In Internet Appendix Figure 1C we identify the geographic region of an institution by using FactSet item "ISO_country", which reports the country in which a security is domiciled. We do not use the fund country of incorporation since "ISO_country" better matches the location of the entity headquarters provided by the variable metro_area that reports the metropolitan area of the fund headquarters. Continental Europe includes Malta and Iceland. Our FactSet data covers the year 2015.

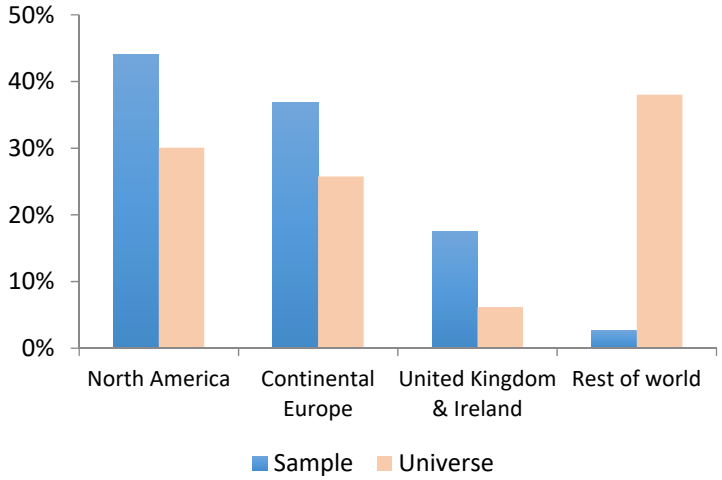
I.A. Figure 1A: Institutional investor type



I.A. Figure 1B: Assets under management



I.A. Figure 1C: Region



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