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RESEARCH ARTICLE

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# Shareholder activism and firms' voluntary disclosure of climate change risks

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**Abstract**

**Research Summary:** This article examines whether—in the absence of mandated disclosure requirements—shareholder activism can elicit greater disclosure of firms' exposure to climate change risks. We find that environmental shareholder activism increases the voluntary disclosure of climate change risks, especially if initiated by institutional investors, and even more so if initiated by long-term institutional investors. We also find that companies that voluntarily disclose climate change risks following environmental shareholder activism achieve a higher valuation postdisclosure, suggesting that investors value transparency with respect to firms' exposure to climate change risks.

**Managerial Summary:** Climate change poses increasing risks to companies. Yet, despite the growing importance of climate change risks, little is known about companies' exposure to climate change risks, their disclosure of these risks, and what strategic actions they take to manage and mitigate these risks. In this study, we examine whether—in the absence of mandatory disclosure—shareholders can elicit greater corporate transparency with respect to climate change risks. We find that

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shareholder activism is effective, especially if initiated by long-term institutional investors. We also find that the stock market reacts positively to companies' climate risk disclosure following environmental shareholder activism, suggesting that investors value transparency with respect to firms' exposure to climate change risks.

**KEYWORDS**

climate change, climate risk, corporate disclosure, corporate governance, shareholder activism

## 1 | INTRODUCTION

Managers increasingly face shareholder pressure to disclose and manage their exposure to climate change risks. For example, in May 2017, the shareholders of ExxonMobil voted for a comprehensive assessment of risks related to climate change (New York Times, 2017). Shareholders of Occidental Petroleum Corporation, PPL Corp, and many other companies have also demanded greater disclosure of climate change risks (Wall Street Journal, 2018a). More generally, companies faced a record number of climate-related shareholder proposals at their 2019 shareholder meetings (Wall Street Journal, 2019). This increase in shareholder pressure is not only reflected in the exploding number of shareholder proposals submitted, but also in the increasing shareholder support and approval rates (Flammer, 2015; Wall Street Journal, 2018a).

One reason for this surge in climate-related shareholder activism is the growing recognition of increased costs and risks associated with climate change (New York Times, 2018, 2020; World Economic Forum, 2020). Many companies—from Silicon Valley tech firms to European financial institutions—are increasingly bracing for the direct and indirect impacts of climate change on their bottom lines, as extreme weather conditions pose major risks to their operations and supply chains (CDP, 2016; New York Times, 2019).[1] Given the global reach of climate change, firms across industries and regions are exposed to climate change risks, regardless of their own emission levels.

The second reason for climate-related shareholder activism is the fact that, in many countries (including the United States), the disclosure of nonfinancial information is not mandated

[1]For example, flooding and fiercer storms recently disrupted U.S. drug maker Eli Lilly's manufacturing facilities in Puerto Rico after Hurricane Maria in 2017. The Japanese manufacturer Hitachi Ltd. reports that increased rainfall and flooding in Southeast Asia could disrupt its supply chain. Banco Santander Brasil, a large Brazilian bank, anticipates that increasingly severe droughts might hurt borrowers' ability to repay loans. Pacific Gas and Electric (PG&E), California's largest electric utility, faces increased wildfire risk, partly driven by global warming. In fact, the company was held liable (facing at least $30 billion in fire liabilities) for the disastrous 2018 California wildfire—the deadliest to date—and filed for bankruptcy protection in early 2019 (Forbes, 2019). Google's parent company, Alphabet Inc., expects that rising temperatures could increase the cost of cooling its energy-intensive data centers. All these examples feature direct impacts of climate change. In addition, climate change may also hurt companies indirectly. For example, energy companies face a significant financial risk of so-called "stranded assets"—coal, oil, and gas reserves that companies list as part of their assets, but might in fact be worthless, since those reserves may never be drilled but instead be left stranded due to stricter regulations intended to curb climate change (e.g., Financial Times, 2015; Fortune, 2015). Such assets also include buildings in high-risk flood zones, power plants that may need to shut down, etc. (New York Times, 2019).

by law. For example, the U.S. Securities and Exchange Commission currently merely recommends that companies disclose their climate change risks, but neither mandates such disclosure nor offers any guidance on what information to provide.[2] As a result, companies often provide limited (if any) information.[3]

For the above reasons, it is not surprising that investors incorporate the climate risk exposure of their portfolio companies into their decision-making and are increasingly vested in companies' disclosure of climate risks and their efforts to manage those risks (Ceres, 2018; Financial Times, 2017, 2018, 2020; Krueger, Sautner, & Starks, 2020; New York Times, 2017; Wall Street Journal, 2018a, 2019).[4] In fact, a recent survey of 439 institutional investors paints a striking picture: the majority believe that climate risk reporting is *as important as* financial reporting, and one-third believe that climate risk reporting is *even more important* (Krueger et al., 2020).

Despite the growing importance of climate change risks, little is known about companies' exposure to climate change risks, their disclosure of such risks, and what strategic actions they take to manage and mitigate those risks. Instead, scholarly attention has focused on the participation in voluntary initiatives (e.g., the Climate Leaders Program) and the disclosure of greenhouse gas emissions (e.g., Fisher-Vanden & Thorburn, 2011; Jira & Toffel, 2013; Kim & Lyon, 2011a, 2011b; Krueger, 2015a; Lewis, Walls, & Dowell, 2014; Lyon & Maxwell, 2011; Matisoff, 2013; Reid & Toffel, 2009). Yet, a firm's carbon footprint and participation in climate-related initiatives are very different from a firm's exposure to climate change risks. The latter pertains to the threat of damage, injury, liability, loss, or any other harm to the company that could be caused by climate-related events. In particular, climate change risks include physical risks (such as flooding, fierce storms, drought, and extreme temperatures), regulatory risks arising from current and expected governmental policies related to climate change (such as energy efficiency standards and carbon trading schemes), and other climate-related risks (such as reputation, changing consumer behavior, and increasing humanitarian demands).[5] Importantly, firms across industries face exposure to climate change risks, *regardless* of their own emission levels.[6]

[2]While the SEC requested public feedback in 2016 about potentially changing the climate-related risks required for disclosure in SEC filings, action on this front has stalled since President Donald Trump's election that year. The discussion around mandatory disclosure of climate change risks has since regained traction with several Democratic presidential candidates in 2019 putting forward proposals on how to address climate change (Politico, 2019).

[3]As Ho (2018) highlights, federal securities law requires public companies to disclose in their annual reports "material risk factors, material impacts of risk events, and known future trends or uncertainties that are reasonably likely to affect the companies' financial performance" (p. 411). Hence, in principle, companies should already disclose nonfinancial information that is material to investors. Yet, as Ho further notes, "because these disclosure rules do not specifically address nonfinancial risk and because some issuers do not believe this information to be material to investors under any circumstances, investors increasingly are dissatisfied with the limited nonfinancial information companies currently provide in their financial reports" (p. 411).

[4]This increase in investors' interest in the disclosure of climate risk information—and ESG information more generally—is also reflected in the rapid increase in the number of signatories of the United Nations' Principles for Responsible Investment network. Launched in 2016, this network has grown to over 3,000 signatories and $100 trillion in assets under management in August 2020. Similarly, the Coalition for Environmentally Responsible Economies (Ceres) reports that concerns about environmental and social risks increasingly influence investors' decision-making—in 2016, responsible investment accounted for 26%, or $22.89 trillion, of all professionally managed assets globally—and investors pay close attention to corporate disclosure informing them about companies' climate risk exposure and strategies to address these risks (Ceres, 2018).

[5]See CDP (2016) for a detailed characterization of climate change risks.

[6]A case in point is the insurance industry, which faces tremendous exposure to climate change risks despite its low emission levels (see, e.g., Wall Street Journal, 2018b).

This study advances the literature by focusing on firms' exposure to climate change risks. Specifically, we theoretically and empirically examine whether, in the absence of public governance, private governance—in the form of shareholder activism—can elicit greater disclosure of firms' exposure to climate change risks along with information on how firms are managing those risks (henceforth "climate risk information").[7] We further explore the heterogeneity among shareholders, characterizing which shareholders are particularly effective in eliciting such disclosure. Finally, we examine the valuation implications to assess whether investors value the disclosure of climate risk information.

To conduct the analysis, we merge a novel proprietary dataset from CDP (formerly, the Carbon Disclosure Project) on the disclosure of climate risk information with the Institutional Shareholder Services (ISS) database that compiles information on shareholder activism. Consistent with our arguments, we find that environmental shareholder activism (measured by the number of environment-related proposals submitted by the firm's shareholders) induces managers to voluntarily disclose climate risk information. We further find that environmental shareholder activism is particularly effective if it is initiated by institutional investors, and even more so if it is initiated by institutional investors that have a long-term horizon. Finally, we find that companies that voluntarily disclose climate risk information following environmental shareholder activism achieve a higher valuation postdisclosure, suggesting that investors value the voluntary disclosure of the firm's exposure to climate risks. Overall, our findings highlight shareholders' ability to elicit greater disclosure of climate risk information, and further indicate that such disclosure is valuable to investors.

In the analysis, we consider the potential endogeneity of environmental shareholder activism with respect to climate risk disclosure. Because environmental shareholder activism is not randomly assigned to companies, it might be correlated with unobservables that also affect climate risk disclosure. To address this concern, we exploit the fact that shareholder activism often comes in "waves": a given shareholder adopts an agenda and submits the same proposal to all firms in her portfolio. In such cases, the active shareholder targets a wide set of firms (regardless of their characteristics)—that is, the targeting itself is plausibly exogenous with respect to any specific firm characteristics. Our results continue to hold when using such "waves" as instrument, suggesting that they are unlikely to be driven by endogeneity.

This study contributes to several strands of the literature. First, as mentioned above, by examining the disclosure of firms' *exposure to climate change risks*, we complement the literature that studies the disclosure of firms' *environmental impact* (e.g., Kim & Lyon, 2011b; Lewis et al., 2014; Marquis, Toffel, & Zhou, 2016). Second, by studying the *voluntary* disclosure of firms' climate change risk exposure, we add to the literature that examines the *mandatory* disclosure of firms' nonfinancial information (e.g., Ioannou & Serafeim, 2019; Krueger, 2015a). Third, this study contributes to the strategy and management literature that examines how shareholders shape corporate behavior (e.g., Chen & Feldman, 2019; DesJardine & Durand, 2020; Reid & Toffel, 2009; Wiersema, Ahn, & Zhang, 2020). While this literature typically considers shareholders as one homogenous group, or only considers one specific subset of

[7]Anecdotal evidence suggests that shareholder activism can indeed elicit the disclosure of climate risk information. For example, CNN Business (2017) describes the recent volte-face of ExxonMobil as follows: "ExxonMobil has agreed to reveal the risks it faces from climate change and the global crackdown on carbon emissions. It's a major reversal for the world's biggest publicly traded oil company. Exxon aggressively fought a shareholder proposal in May to disclose how the changing climate could hurt the company. The proposal wasn't binding, but 63% of shareholders supported it—a rare rebuke that forced Exxon to rethink its stance."

shareholders (e.g., hedge funds), our study accounts for the heterogeneity among shareholder types and examines how these differences influence corporate behavior.

Finally, the findings of this study have important implications for practice. In particular, they highlight investors' ability to elicit greater corporate transparency with respect to climate change risks and thereby contribute to their portfolio companies' governance. In absence of mandatory disclosure requirements, this greater ability also implies that investors have a greater responsibility to be active owners and engage with their portfolio companies to elicit the disclosure of their climate risk exposure.

## 2 | THEORY

### 2.1 | Voluntary disclosure of climate risks as a governance issue

Disclosing climate risk information provides companies with several benefits, but also has downsides. First, one benefit is that transparency can increase firms' accountability in the public's eye and, as a result, strengthen their commitment to manage and mitigate these risks going forward. Second, transparency allows the firms' investors, business partners, and other stakeholders to engage with the disclosing firms in a more informed fashion, enabling them to be more effective in helping them manage and mitigate their climate risks. For example, they may advise firms to diversify their supplier base across geographic regions to minimize disruptions due to severe weather events, or advise them to shift their product mix toward energy-efficient products to cater to changing consumer preferences, improve their reputation, and comply with current or expected future governmental climate policies. Third, transparency can foster trust, allowing companies to strengthen their (long-term) relationships with investors and other stakeholders. As these examples illustrate, the disclosure of climate risk information—describing the firm's exposure to climate risks as well as the firm's efforts to manage and mitigate these risks—can improve the governance of the firm, which in turn can contribute to the firm's long-term value.

On the other hand, the disclosure of climate risk information also has potential downsides. In particular, it may reveal vulnerabilities that companies would prefer to keep from investors, competitors, customers, and other stakeholders. These vulnerabilities may include risks pertaining to the damage, injury, liability, loss, or any other climate-related harm to the company. For example, the disclosure may reveal the firm's exposure to extreme temperatures and weather events (such as flooding, hurricanes, droughts, and wildfires) that can disrupt the firm's operations and supply chain, inhibit borrowers' ability to repay loans, increase costs for heating and cooling, and so forth (e.g., Forbes, 2019). Furthermore, the disclosure may reveal the firm's financial risk associated with so-called "stranded assets"—that is, assets that are listed in the books, but might in fact need to be written off or retired early as they may be left stranded due to stricter regulations intended to curb climate change. Such assets include buildings in high-risk flood zones, power plants that may need to be shut down, and fossil fuel reserves (coal, oil, and gas) that may never be drilled due to stricter regulations, among others (e.g., Financial Times, 2015; Fortune, 2015; New York Times, 2019).

In addition to revealing potential vulnerabilities, disclosing climate risk information entails direct costs. Firms need to dedicate human capital to compiling and reporting information about the climate change risks they face, along with their strategies to address them. Arguably these costs are especially high for firms that are not yet aware of their own climate risk

exposure and need to first conduct a thorough assessment of the physical risks, regulatory risks, and market risks that climate change poses to their business, and then incorporate this assessment into their risk management and business plans to better manage and mitigate their climate risk exposure going forward.

From the management's perspective, another potential downside of disclosing climate change risks is that investors, business partners, and other stakeholders may respond to the disclosed information in a way that hurts the company. For example, investors might use this information to rebalance their portfolios, reallocating funds away from the disclosing company to other companies with more favorable risk–return profiles. Relatedly, suppliers and corporate clients might decide to sever their relationship with the disclosing company, and instead shift their focus to other companies that are less exposed to climate risks and hence appear to be more viable business partners in the long run. In sum, considering the potential downsides of disclosure, managers might be reluctant to disclose their firm's exposure to climate risks.

We expect this reluctance to disclose climate change risks to be further accentuated by the temporal separation between the potential downsides (which tend to occur primarily in the short run) and upsides (which tend to materialize in the long run) of disclosing climate risk information. A large literature in psychology and economics suggests that individuals are "hyperbolic discounters," that is, they have an excessive preference for the present, preferring short-term rewards over long-term rewards even if the latter are substantially higher (e.g., Ainslie, 1975; Frederick, Loewenstein, & O'Donoghue, 2002; Loewenstein & Prelec, 1992; O'Donoghue & Rabin, 1999; Thaler & Shefrin, 1981). This preference for short-term results is likely reinforced for executives as they face short-term pressures, such as career concerns (e.g., Gibbons & Murphy, 1992) and pressures to meet or beat analysts' quarterly earnings expectations (e.g., DeGeorge, Patel, & Zeckhauser, 1999). As a result, managers tend to favor investments that pay off in the short run at the expense of long-term investments (e.g., Graham, Harvey, & Rajgopal, 2005; Holmstrom, 1999; Stein, 1988, 1989). It follows that shareholders face a "time-based agency conflict" (Flammer & Bansal, 2017)—that is, managers have an excessive preference for the present, and hence might not act in shareholders' (long-term) best interest. This time-based agency conflict implies that managers will likely put more weight on the potential short-term downsides of climate risk disclosure, as opposed to the potential long-term upsides of managing and mitigating climate risks.

A second implication of this time-based agency conflict is that managers may focus their attention on stakeholders that have short-term financial performance implications (e.g., customers and employees) at the expense of stakeholders that may be financially material to the company's operations in the long run but not necessarily in the short run (e.g., communities and the natural environment).[8] Accordingly, as managers devote less attention to the natural environment, they may simply be unaware of the risks climate change poses to their business.

Taken together, the above arguments suggest that, in the absence of public governance, managers may prefer to not disclose their company's exposure to climate change risks. In the following, we explore circumstances under which *private* governance—through pressure from different types of shareholders—might induce companies to nevertheless disclose their climate change risks.

[8]For a similar characterization of the different types of stakeholders, see, for example, Eesley and Lenox (2006), Flammer, Hong, and Minor (2019), and Mitchell, Agle, and Wood (1997).

## 2.2 | Shareholder activism and the voluntary disclosure of climate risk information

To mitigate the gap between what investors demand and what companies provide, investors can exert pressure through shareholder activism demanding managerial actions such as the reassessment of organizational practices and the disclosure of information. Indeed, investors often pressure managers to disclose and address social and environmental issues and this pressure has increased over the years (e.g., Flammer, 2015).

A priori, it is far from obvious whether shareholders can trigger myopic managers to voluntarily disclose climate risk information since most shareholder proposals receive little support at annual meetings.[9] In other words, the majority of shareholders tend to vote against shareholder-sponsored resolutions. Accordingly, one might expect management to pay little attention, if any, to the demands of those few shareholders sponsoring and supporting the proposals, and instead maintain their practice of not disclosing the firm's exposure to climate change risks or how the firm is managing them. On the other hand, it could also be that—despite low support at annual meetings—environmental shareholder activism does trigger companies to disclose climate risk information. In the following, we discuss two potential reasons: environmental shareholder activism may (a) trigger a reevaluation of the upside and downside of climate risk disclosure, and (b) increase management's awareness of the firm's exposure to climate risks.

First, despite the low support that shareholder proposals garner, studies indicate that shareholder activism—pertaining to a wide range of subject matters (e.g., executive compensation, antitakeover provisions, social and environmental practices)—can nevertheless be impactful and induce management to reevaluate and adjust their business practices in line with the aims of the proposals (e.g., Cuñat et al., 2012; Flammer, 2015; Flammer & Bansal, 2017; McDonnell, King, & Soule, 2015; Vasi & King, 2012).[10] In this spirit, environmental shareholder activism may induce managers to reassess the pros and cons of disclosing their company's climate risk exposure, putting more weight on the pros, and less weight on the cons.

In particular, following shareholders' demand for climate risk disclosure, managers may reconsider the potential upside of complying with the investors' demands, putting more weight on the benefits of communicating to investors the firm's exposure to climate risks and their strategic plans to better manage and mitigate these risks going forward. Such improved transparency is likely valued by investors, as it helps strengthen investors' trust and their relationship with the disclosing company, allowing them to engage with the management in an informed manner and provide advice on how to best move forward in managing and mitigating these risks.

Similarly, when pressured by their shareholders, managers may put less weight on the downside of disclosing climate risk information and revealing potential vulnerabilities. Arguably, shareholders who express concerns about climate change risks and demand higher transparency in this regard may do so in a collaborative fashion, being primarily interested in

[9]This is a common feature of shareholder proposals. For example, Flammer (2015) finds that the average vote outcome for SRI proposals is 13.5% (p. 2553). Similarly, Cuñat, Giné, and Guadalupe (2012) find that the average shareholder vote on governance proposals is 36.2% (p. 1949).

[10]Relatedly, other environmental activist campaigns (such as boycotts, protests, and private politics) are found to improve firms' environmental practices (Lenox & Eesley, 2009) and elicit greater corporate transparency (Reid & Toffel, 2009).

knowing that the firm is indeed aware of its climate risk exposure and takes actions to mitigate these risks (as opposed to using this information to reallocate funds away from the company).

Second, environmental shareholder activism may increase managers' awareness of the firm's exposure to climate risks. Specifically, environmental shareholder activism may induce managers to pay (more) attention to the natural environment—a stakeholder that myopic managers might otherwise neglect (Flammer et al., 2019)—making them more aware of the firm's vulnerability to climate change risks. In turn, this could induce managers to conduct an assessment of the firm's exposure to climate change risks; incorporate these data into the firm's risk management and strategic plans to better manage and mitigate these risks going forward; and disclose the firm's climate risk information to the public.

Taken together, the above arguments suggest that companies are more likely to disclose climate risk information when facing shareholder pressure. This motivates our baseline hypothesis:

**Hypothesis (H1).** *Environmental shareholder activism increases companies' voluntary disclosure of climate change risk information.*

## 2.3 | Heterogeneity in shareholders demanding climate risk disclosure

Investors are not one homogenous group. Rather, there is considerable heterogeneity in terms of their objectives, preferences, and time horizons, among others. These differences are likely to have important implications for their interactions with their portfolio companies. In the following, we refine our arguments and explore how the effectiveness of shareholder activism to induce the disclosure of climate change risk information depends on the active shareholders' characteristics. That is, we decompose the effect of shareholder activism on the disclosure of climate change risks by investor type.

### 2.3.1 | Institutional investors

A company's investor base consists of institutional and noninstitutional investors. In contrast to noninstitutional investors, institutional investors (such as asset management funds, hedge funds, mutual funds, and public pension funds) tend to hold large stakes in their portfolio companies—which makes them particularly vulnerable to their portfolio companies' climate risk exposure—and often have dedicated staff members who monitor them.

As such, institutional investors have both incentives and resources to identify governance issues, including those pertaining to the disclosure of climate change risks, raise these issues to the management's attention, and provide advice on how to address these issues. Moreover, they are better able to mobilize other shareholders and garner support for their proposals, further increasing their ability to pressure the management. For these reasons, we expect institutional investors to play an important role in their portfolio companies' decision to disclose climate risk information.

These arguments are in line with the existing literature's finding that institutional investors tend to actively monitor and engage with their portfolio companies, playing a leading role in shaping their governance (e.g., Bethel & Liebeskind, 1993; Chen, Dong, and Lin, 2020; Dimson,

Karakas, & Li, 2015; Gillan & Starks, 2000; Ilhan, Krueger, Sautner, & Starks, 2019; Krueger et al., 2020; Shleifer & Vishny, 1986).[11] Furthermore, shareholder proposals initiated by institutional investors tend to receive more support among other shareholders (e.g., Flammer, 2015; Gillan & Starks, 2000).

In contrast, noninstitutional investors have weaker incentives and often lack the necessary resources to monitor and actively engage with the management, as they tend to be smaller, more resource-constrained, and can free ride on the monitoring and costly engagement of institutional investors (Grossman & Hart, 1980; Shleifer & Vishny, 1986). Moreover, even if they do actively engage with the management, they are likely less able to coordinate with other shareholders and garner broad support for their shareholder proposals (Gillan & Starks, 2000).

Taken together, these arguments suggest that institutional investors are likely to be more effective in inducing their portfolio companies to disclose climate-related risks. Their influence is likely reinforced by the potential downside of not addressing their demands. Failing to disclose climate risk information may lead institutional investors to sell their shares and rebalance their portfolios toward companies that are willing to disclose climate risk information. Even if disclosing climate risk information reveals vulnerabilities that the companies would prefer to keep private, the downside of not complying with the demands of institutional investors may be higher, tilting the balance closer toward disclosure.

In sum, we expect that environmental shareholder activism initiated by institutional investors is more likely to induce managers to report on the firm's climate risk information. This motivates the following hypothesis:

**Hypothesis (H2).** *Companies are more likely to voluntarily disclose climate change risk information if the environmental shareholder activism is initiated by institutional investors.*

### 2.3.2 | Institutional investors' time horizons

Institutional investors differ in their time horizons. In particular, "transient" investors tend to hold companies' stocks on a short-term basis (e.g., driven by speculation motives), while long-term investors hold stocks for a longer period of time, taking a vested interest in the companies' long-term success (Bushee, 1998, 2001; Gaspar, Massa, & Matos, 2005). In the following, we decompose the effect of institutional investors on the disclosure of climate change risks by the institutional investors' time horizon. We expect that shareholder activism initiated by long-term institutional investors is more effective in inducing the management to voluntarily disclose climate change risk information (compared to shareholder activism initiated by short-term institutional investors). The rationale is twofold.

First, when the activism is initiated by long-term institutional investors, we expect managers to put less weight on the short-term downsides of climate risk disclosure. As long-term institutional investors tend to hold stable portfolios, they are less likely to withdraw their funds in the short run upon the announcement of negative information (Starks, Venkat, & Zhu, 2017).

[11]See also the related literature on hedge fund activism that examines the various ways in which hedge funds pressure the management to rectify potential inefficiencies (e.g., Chen & Feldman, 2019; DesJardine & Durand, 2020; Wiersema et al., 2020). As mentioned above, hedge funds are one specific example of institutional investors. A distinguishing feature of hedge fund activism is that hedge funds often acquire large ownership stakes in companies they believe are being mismanaged (and hence undervalued), and then pressure the management to take corrective action in an effort to increase the firm's valuation and hence generate high investment returns.

Instead, they take a vested interest in improving the firms' business practices and are more inclined to actively engage with their portfolio companies in order to improve corporate governance and the long-term value of the firm (Krueger et al., 2020; Neubaum & Zahra, 2006). Building on these insights, we expect that long-term institutional investors are less likely to reallocate their holdings away from the disclosing companies in case the disclosure reveals unexpected vulnerabilities to climate risks. Accordingly, management is less likely to face an "exit" (i.e., a divestment) of these investors in case the voluntarily disclosed information on climate risks sheds a negative light on the company, which mitigates the potential downside of disclosing climate change risks. Moreover, managers are likely to put more weight on the long-term upsides of disclosure given that long-term institutional investors have a vested interest in the company's long-term success. When demanding the disclosure of climate change risk information, long-term institutional investors are more likely to do so for the sake of being informed and in an effort to help their portfolio companies develop strategies to manage and mitigate their climate risk exposure going forward. This, in turn, elevates the potential upside of disclosure.

Second, shareholder activism initiated by long-term institutional investors might trigger managers to pay more attention to the natural environment, thereby increasing their awareness of the potential impact of climate change on their organization, and inducing them to invest resources in the assessment, management, and disclosure of their climate risk exposure. Indeed, climate change is an especially complex issue and—despite extensive scientific evidence—it has been disputed by climate change deniers and other vocal critics.[12] Given the complex and contested nature of climate change, we expect that management is more likely to listen to shareholder demands and consider the disclosure of their climate risk information if brought forward by shareholders whose interests are more closely aligned with the firm's ability to thrive in the long run.

In sum, we posit that the requests of long-term institutional investors are likely more effective in eliciting the voluntary disclosure of climate change risk information. This leads to the following hypothesis:

**Hypothesis (H3).** *Companies are more likely to voluntarily disclose climate change risk information if the environmental shareholder activism is initiated by long-term institutional investors.*

# 3 | DATA

## 3.1 | Data sources

### 3.1.1 | Climate change risk disclosure

The data on climate change risk disclosure are obtained from CDP, a nonprofit organization based in London. Each year, CDP asks large public companies to disclose information about the risks and opportunities posed by climate change, their strategies to address them, and other environment-related information. By participating in this process, companies are able to voluntarily disclose information to investors in a structured fashion. In 2016, 67% of the S&P 500 companies disclosed at least some of this information to CDP. We obtained annual CDP data for the

[12]See, for example, the scientific controversy as to whether East Antarctica is gaining or losing mass, summarized in Scientific American (2017).

years 2010–2016, the time frame during which the CDP survey consistently asked about climate risk information. We focus on S&P 500 companies because this is the sole overlap between the coverage of CDP and that of ISS, described next.

#### 3.1.2 | Shareholder activism

The data on shareholder activism are obtained from the ISS database. ISS compiles information about shareholder proposals that were submitted to S&P 1,500 companies from 1997 onward. The database distinguishes between shareholder proposals on governance topics and those on socially responsible investing (SRI) topics. For each proposal, the database provides a description of the proposal, the date of the annual meeting, the proposal's sponsor, the voting requirement, and several other attributes.

In our baseline analysis, we restrict the sample to firms that are targeted by SRI proposals during the sample period. For each firm, we include the years within 2010–2016 that range from its earliest SRI proposal through its most recent one. This approach ensures that the firms in our sample face a credible risk of being the target of SRI-related shareholder activism.[13] Our baseline sample consists of 1,110 firm-year observations pertaining to 265 U.S. public firms.

### 3.2 | Definition of variables

#### 3.2.1 | Dependent variable

In the CDP questionnaire (question CC5.1), companies are asked to disclose information on three types of climate change risks: (a) regulatory risks, (b) physical risks, and (c) other risks. *Regulatory risks* arise from current and expected (local, national, or global) governmental policy related to climate change; for example, the imposition of emissions limits, energy efficiency standards, and carbon trading schemes. *Physical risks* are those arising from extreme weather events or subtle changes in weather patterns. *Other risks* include, among others, reputation, changing consumer behavior, induced changes in human and cultural environments, fluctuating socio-economic conditions, and increasing humanitarian demands. (For more details on these three types of risk, see CDP, 2016.) For each type of climate risk they disclose, companies are asked to describe the risk and its potential impact; characterize its timeframe, likelihood, and magnitude of impact; estimate its financial implications before taking mitigating actions; and describe how the risk is being managed and the costs associated with those actions.

Our main dependent variable, *disclosure of climate change risks*, counts how many of these three climate change risks the company discloses (i.e., it ranges from 0 to 3). In auxiliary analysis, we examine each disclosure category separately by using individual indicator variables for the disclosure of regulatory, physical, and other climate change risks, respectively.

[13]Our results are not sensitive to this criterion. In robustness checks, we obtain similar results when we use the broader sample of firms that are targeted by either governance or SRI proposals. In principle, we could further expand the sample by including firms that are never targeted by shareholder proposals. Yet such firms are unlikely to provide an appropriate comparison group; for those firms, the notion "shareholder activism" is not well defined as they do not have active shareholders in the first place.

### 3.2.2 | Independent variables

We measure *environmental shareholder activism* as the number of environment-related shareholder proposals a company faces in a given year. Specifically, we consider all shareholder proposals in ISS for which the field "resolution type" is "SRI," and read the description of these proposals to determine which are environment-related. In our baseline sample, 33% of the 1,110 firm-year observations have at least one environment-related shareholder proposal (the maximum is five).

We also distinguish between environmental shareholder activism exerted by institutional investors—investors who tend to hold large stakes and actively monitor the companies they invest in—and by noninstitutional investors, who are often smaller, individual investors. We code proposal sponsors as noninstitutional if the field "sponsor type" in ISS is "individual," "union," "religious," or "other." All other sponsor types are coded as institutional; this includes public pension funds, SRI funds, special interest investors, and asset management funds.[14]

We further divide institutional investors into those with a long-term or short-term horizon. We categorized all SRI investors and special interest investors as long-term since they are unambiguously long-term given their mandate. For all other institutional investors (such as asset management funds), we use Thomson-Reuters 13F data to calculate investors' quarterly churn rate, which is the extent to which they rebalance their portfolio each quarter.[15] Intuitively, investors who frequently rebalance their portfolio (i.e., high churn rate) have a shorter holding period and hence a shorter time horizon. We then calculate each investor's annual average churn rate, and categorize those above the average churn rate as short-term investors, and those below as long-term investors (Gaspar et al., 2005).[16] For those institutional investors in the ISS data that could not be matched to the Thomson-Reuters 13F data, we create an additional category, "institutional shareholders with unknown temporal horizon."

It is important to note that most of the proposals are defeated in shareholder meetings. This is a common feature of shareholder-sponsored (as opposed to management-sponsored) proposals (see Cuñat et al., 2012; Flammer, 2015). Nevertheless, shareholders often submit proposals not so much because they expect them to pass, but rather to bring important issues to the attention of the management (Loss & Seligman, 2004). As such, the very act of submitting

[14]As a robustness test, we consider an alternative way of distinguishing between noninstitutional and institutional investors. Specifically, we classify individuals as noninstitutional (i.e., investors for which the field "sponsor type" in ISS is "individual"), and all other investors as institutional. This broader definition of institutional investors yields very similar results.

[15]The quarterly CR for investor $i$ in quarter $t$ is computed using the following formula (Gaspar et al., 2005, p. 143):

$$CR_{it} = \frac{\sum_{j \in Q} \left| N_{jit} P_{jt} - N_{jit-1} P_{jt-1} - N_{jit-1} \Delta P_{jt} \right|}{\sum_{j \in Q} \frac{N_{jit} P_{jt} + N_{jit-1} P_{jt-1}}{2}},$$

where $P_{jt}$ and $N_{jit}$ are the stock price of company $j$ in quarter $t$, and the number of shares of company $j$ held by investor $i$ in quarter $t$, respectively.

[16]As a robustness test, we distinguish between short- and long-term institutional investors using Bushee's (2001) classification in lieu of the churn rate. Bushee differentiates between three types of investors: transient, quasi-indexer, and dedicated. We code as short-term institutional investors those that Bushee classifies as "transient," which he defines as institutional owners "characterized as having high portfolio turnover and highly diversified portfolio holdings [...] reflect[ing] the fact that transient institutions tend to be short-term-focused investors whose interest in the firm's stock is based on the likelihood of short-term trading profits" (p. 214). Conversely, we code as long-term investors those Bushee classifies as "quasi-indexer" or "dedicated." This alternative approach yields very similar results as the churn rate. This is not surprising, since Bushee's coarser categorization is itself based on the churn rate.

an environment-related proposal is intended to pressure management to disclose and address environmental issues.

#### 3.2.3 | Controls

All control variables are constructed from Compustat, which we merge to the ISS–CDP dataset by firm-year. *Size* is the natural logarithm of the book value of total assets. *Return on assets* (ROA) is the ratio of operating income before depreciation to the book value of total assets. *Market-to-book* is the ratio of the market value of common stock to its book value. *Leverage* is the ratio of debt (long-term debt plus debt in current liabilities) to the book value of total assets. *Cash holdings* is the ratio of cash and short-term investments to the book value of total assets. To mitigate the impact of outliers, all ratios are winsorized at their 5th and 95th percentiles.

### 3.3 | Descriptive statistics

Table 1 reports summary statistics and correlations. We note the positive correlation between *environmental shareholder activism* and *disclosure of climate change risks*, which is suggestive of Hypothesis (H1) (the correlation is 10%, with a *p*-value of .002).[17]

In Table A1 of the Online Appendix, we report summary statistics for these two variables by industry (partitioned according to SIC divisions). As can be seen, *disclosure of climate change risks* tends to be greatest in mining, manufacturing, and utilities—all industries for which the natural environment is financially material to the firm's operations (based on the materiality scores of the Sustainability Accounting Standards Board [SASB]).[18,19] A similar pattern is found for *environmental shareholder activism*, with the interesting nuance that retail trade is also subject to a high degree of environmental shareholder activism (which likely reflects consumers' sensitivity to environmental issues).[20] Finally, Online Appendix Table A2 reports summary statistics for these two variables by year, which indicate that both the disclosure of climate change risks and environmental shareholder activism have become more prevalent over the years.

## 4 | METHODOLOGY

### 4.1 | Baseline regression

To examine whether environmental shareholder activism induces firms to voluntarily disclose climate change risks, we estimate the following regression:

[17]Note that several variables are highly correlated in Table 1. For example *disclosure of climate change risks* has an 87% correlation with *disclosure of regulatory climate change risks*. However, none of these highly correlated variables are used in the same regression, which avoids multicollinearity issues.

[18]For a description of the SASB data, see Khan, Serafeim, and Yoon (2016).

[19]Construction also displays a high disclosure of climate change risks, but represents only a small fraction of the sample.

[20]Note that institutional ownership (measured as the percentage of shares held by institutional owners from the 13F SEC filings) is similar among firms that are targeted by environmental shareholder activism and firms that are not. In our sample, the average institutional ownership is 74.3% for targeted firms, compared to 77.9% for nontargeted firms.

**TABLE 1** Summary statistics and correlations

| | | Mean | *SD* | Min | Max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Disclosure of climate change risks | 2.206 | 1.161 | 0 | 3 | | | | | | | | | | | | | | | | | | | | |
| 2 | Disclosure of regulatory climate change risks | 0.761 | 0.427 | 0 | 1 | 0.87 | | | | | | | | | | | | | | | | | | | |
| 3 | Disclosure of physical climate change risks | 0.760 | 0.427 | 0 | 1 | 0.88 | 0.65 | | | | | | | | | | | | | | | | | | |
| 4 | Disclosure of other climate change risks | 0.685 | 0.465 | 0 | 1 | 0.89 | 0.65 | 0.69 | | | | | | | | | | | | | | | | | |
| 5 | Environmental shareholder activism | 0.341 | 0.682 | 0 | 5 | 0.10 | 0.09 | 0.05 | 0.11 | | | | | | | | | | | | | | | | |
| | Environmental shareholder activism by... | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | ... noninstitutional investors | 0.118 | 0.407 | 0 | 4 | 0.12 | 0.10 | 0.08 | 0.13 | 0.68 | | | | | | | | | | | | | | | |
| 7 | ... institutional investors | 0.223 | 0.505 | 0 | 3 | 0.03 | 0.05 | 0.00 | 0.04 | 0.81 | 0.11 | | | | | | | | | | | | | | |
| 8 | ... institutional investors with long-term horizon | 0.164 | 0.418 | 0 | 3 | 0.05 | 0.05 | 0.02 | 0.06 | 0.71 | 0.10 | 0.88 | | | | | | | | | | | | | |
| 9 | ... institutional investors with short-term horizon | 0.053 | 0.228 | 0 | 2 | −0.03 | −0.01 | −0.04 | −0.04 | 0.40 | 0.02 | 0.52 | 0.08 | | | | | | | | | | | | |
| 10 | ... institutional investors with unknown temporal horizon | 0.006 | 0.079 | 0 | 1 | 0.04 | 0.04 | 0.02 | 0.05 | 0.24 | 0.12 | 0.24 | 0.08 | 0.03 | | | | | | | | | | | |
| 11 | | 0.037 | 0.189 | 0 | 1 | 0.06 | 0.05 | 0.03 | 0.07 | 0.28 | 0.07 | 0.32 | 0.29 | 0.14 | 0.11 | | | | | | | | | | |

**TABLE 1** (Continued)

| | | Mean | *SD* | Min | Max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Environmental activism wave (5+ proposals) | | | | | | | | | | | | | | | | | | | | | | | | |
| | Environmental activism wave (3+ proposals) by... | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | ... noninstitutional investors | 0.008 | 0.090 | 0 | 1 | 0.03 | 0.03 | 0.00 | 0.04 | 0.09 | 0.20 | −0.04 | −0.04 | −0.02 | −0.01 | 0.36 | | | | | | | | | |
| 13 | ... institutional investors | 0.070 | 0.256 | 0 | 1 | 0.04 | 0.05 | 0.01 | 0.05 | 0.42 | 0.01 | 0.56 | 0.51 | 0.26 | 0.11 | 0.58 | −0.02 | | | | | | | | |
| 14 | ... institutional investors with long-term horizon | 0.058 | 0.233 | 0 | 1 | 0.06 | 0.06 | 0.03 | 0.06 | 0.38 | −0.01 | 0.52 | 0.57 | 0.08 | 0.08 | 0.55 | −0.02 | 0.90 | | | | | | | |
| 15 | ... institutional investors with short-term horizon | 0.014 | 0.116 | 0 | 1 | −0.05 | −0.03 | −0.06 | −0.04 | 0.20 | 0.04 | 0.24 | 0.03 | 0.49 | −0.01 | 0.18 | −0.01 | 0.43 | 0.04 | | | | | | |
| 16 | ... institutional investors with unknown temporal horizon | 0.001 | 0.030 | 0 | 1 | −0.01 | 0.02 | −0.05 | 0.02 | 0.03 | −0.01 | 0.05 | −0.01 | −0.01 | 0.38 | 0.15 | 0.00 | 0.11 | −0.01 | 0.00 | | | | | |
| 17 | Size | 10.502 | 1.332 | 7.577 | 14.761 | 0.02 | −0.02 | 0.05 | 0.03 | 0.14 | 0.18 | 0.05 | 0.07 | −0.04 | 0.06 | −0.02 | 0.05 | −0.01 | 0.07 | −0.04 | 0.06 | | | | |
| 18 | ROA | 0.139 | 0.071 | 0.018 | 0.302 | −0.03 | −0.02 | −0.07 | 0.00 | 0.05 | 0.03 | 0.04 | 0.02 | 0.05 | 0.01 | 0.07 | 0.05 | 0.06 | 0.02 | 0.05 | 0.01 | −0.47 | | | |
| 19 | Market-to-book | 3.297 | 2.519 | 0.706 | 9.971 | −0.11 | −0.10 | −0.12 | −0.07 | −0.01 | −0.06 | 0.03 | 0.01 | 0.06 | −0.02 | 0.04 | 0.01 | 0.08 | 0.01 | 0.06 | −0.02 | −0.33 | 0.60 | | |
| 20 | Leverage | 0.256 | 0.140 | 0.002 | 0.579 | 0.16 | 0.18 | 0.09 | 0.14 | 0.00 | −0.04 | 0.03 | 0.03 | 0.02 | −0.03 | 0.01 | 0.01 | 0.05 | 0.03 | 0.02 | −0.03 | −0.04 | −0.07 | 0.14 | |
| 21 | Cash holdings | 0.121 | 0.110 | 0.006 | 0.415 | −0.05 | −0.09 | −0.03 | −0.02 | −0.14 | −0.10 | −0.11 | −0.11 | −0.03 | −0.05 | −0.02 | −0.03 | −0.08 | −0.11 | −0.03 | −0.05 | −0.02 | 0.20 | 0.15 | −0.31 |

*Note:* $N = 1{,}110$ firm-year observations.
Abbreviation: ROA, *Return on assets.*

**TABLE 2** Shareholder-induced disclosure of climate change risks

| | Disclosure of climate change risks$_t$ | |
|---|---|---|
| **Dependent variable** | **(1)** | **(2)** |
| Environmental shareholder activism$_{t-1}$ | 0.103 (0.045) | 0.101 (0.043) |
| Size$_{t-1}$ | | −0.206 (0.280) |
| ROA$_{t-1}$ | | 0.471 (1.616) |
| Market-to-book$_{t-1}$ | | 0.024 (0.021) |
| Leverage$_{t-1}$ | | 0.989 (0.551) |
| Cash$_{t-1}$ | | 1.443 (0.989) |
| Firm fixed effects | Yes | Yes |
| Year fixed effects | Yes | Yes |
| Within *R*-squared | .12 | .13 |
| #Observations (firm-years) | 1,110 | 1,110 |
| #Firms | 265 | 265 |

*Note:* OLS estimates with *SE*s clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.
Abbreviations: OLS, ordinary least squares; ROA, *Return on assets*.

$$\textit{disclosure of climate change risks}_{it} = \alpha_i + \alpha_t + \beta \times \textit{environmental shareholder activism}_{it-1} + \gamma' \mathbf{X}_{it-1} + \varepsilon_{it} \quad (1)$$

where $i$ indexes firms, $t$ indexes years, $\alpha_i$ are firm fixed effects, and $\alpha_t$ are year fixed effects. All other right-hand-side variables are lagged by one year. $\mathbf{X}$ is the vector of control variables, which includes *size*, *ROA*, *market-to-book*, *leverage*, and *cash holdings*. $\varepsilon$ is the error term. The regression is estimated by ordinary least squares (OLS). To account for dependence across firms within the same industry, we cluster *SE*s at the industry level. Throughout the analysis, industries are partitioned according to SIC divisions, using the company's primary SIC code from Compustat (which is based on the company's industry that has the largest revenues). The coefficient of interest is $\beta$, which captures the change in the voluntary disclosure of climate change risks following environmental shareholder activism.

The inclusion of control variables mitigates the possibility that our findings are driven by omitted variables. For example, it could be that larger companies are more likely to voluntarily disclose climate change risks (e.g., due to more intense public scrutiny) and be targeted by environmental shareholder activism. Controlling for size addresses this potential confound. Similarly, the other controls account for differences in performance (*ROA* and *market-to-book*) and financing policies (*leverage* and *cash holdings*) that may correlate with both the decision to disclose climate change risks and environmental shareholder activism. The inclusion of firm fixed effects accounts for unobserved heterogeneity at the firm level. The inclusion of year fixed effects accounts for any time trend that could influence both the voluntary disclosure of climate change risks and environmental shareholder activism.

## 4.2 | Two-stage least squares regression

While the controls and fixed effects help address potential confounds, they do not rule out the possibility that *unobservable* time-varying firm characteristics might drive a spurious

**TABLE 3** Shareholder-induced disclosure of climate change risks (2SLS)

| | First stage | | Second stage | |
|---|---|---|---|---|
| | Environmental shareholder activism$_{t-1}$ | | Disclosure of climate change risks$_t$ | |
| Dependent variable | (1) | (2) | (3) | (4) |
| Environmental shareholder activism (instr.)$_{t-1}$ | | | 0.337 (0.148) | 0.350 (0.126) |
| Environmental activism wave$_{t-1}$ | 0.911 (0.098) | 0.913 (0.095) | | |
| Size$_{t-1}$ | | −0.003 (0.073) | | −0.196 (0.227) |
| ROA$_{t-1}$ | | −0.234 (0.441) | | 0.553 (1.389) |
| Market-to-book$_{t-1}$ | | 0.016 (0.014) | | 0.020 (0.018) |
| Leverage$_{t-1}$ | | −0.069 (0.475) | | 1.020 (0.464) |
| Cash$_{t-1}$ | | 0.249 (0.625) | | 1.435 (0.834) |
| Firm fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| *F*-statistic (instrument) | 85.55 | 91.90 | – | – |
| Within *R*-squared | .11 | .11 | .09 | .10 |
| #Observations (firm-years) | 1,110 | 1,110 | 1,110 | 1,110 |
| #Firms | 265 | 265 | 265 | 265 |

*Note:* 2SLS estimates with *SE*s clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions. Abbreviations: 2SLS, two-stage least squares; ROA, *Return on assets*.

relationship between environmental shareholder activism and companies' disclosure of climate change risks.[21] In additional analyses, we alleviate this concern by using an instrumental variable.

To construct an instrument for environmental shareholder activism, we exploit the fact that shareholder activism often comes in "waves." That is, a particular shareholder (such as BlackRock or CalPERS) adopts an agenda (for example, requesting companies to provide a climate risk report) and then submits a similar proposal to all firms in which it has nontrivial holdings (e.g., Gillan & Starks, 2007; Yermack, 2010). In such a case, the active shareholder targets a wide range of firms across industries and geographies, and the shareholder's motive of doing so is orthogonal to (unobservable) characteristics of individual firms. In other words, environment-related proposals that are submitted as part of a wave are more likely to be exogenous with respect to any specific firm characteristics. See also Flammer and Bansal (2017), who use a similar instrument for the submission of long-term compensation proposals.

[21] For example, firms that adopt a more transparent corporate culture are likely to disclose more information, while at the same time higher transparency might be conducive to more shareholder engagement. Or it could be that firms with better investment opportunities attract more attention from shareholders (who then submit more proposals), while at the same time these firms can more easily afford to disclose information about their risk exposure.

**TABLE 4** Shareholder-induced disclosure of various types of climate change risks

| | Disclosure of regulatory climate change risks$_t$ | Disclosure of physical climate change risks$_t$ | Disclosure of other climate change risks$_t$ |
|---|---|---|---|
| **Dependent variable** | **(1)** | **(2)** | **(3)** |
| Environmental shareholder activism$_{t-1}$ | 0.028 (0.015) | 0.039 (0.014) | 0.035 (0.019) |
| Size$_{t-1}$ | −0.038 (0.102) | −0.100 (0.113) | −0.068 (0.101) |
| ROA$_{t-1}$ | 0.278 (0.541) | 0.310 (0.387) | −0.117 (0.759) |
| Market-to-book$_{t-1}$ | 0.011 (0.004) | 0.006 (0.008) | 0.007 (0.011) |
| Leverage$_{t-1}$ | 0.452 (0.217) | 0.262 (0.205) | 0.275 (0.231) |
| Cash$_{t-1}$ | 0.399 (0.215) | 0.447 (0.345) | 0.597 (0.576) |
| Firm fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Within *R*-squared | .11 | .13 | .08 |
| #Observations (firm-years) | 1,110 | 1,110 | 1,110 |
| #Firms | 265 | 265 | 265 |

*Note:* OLS estimates with *SE*s clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.
Abbreviations: OLS, ordinary least squares; ROA, *Return on assets*.

More precisely, our instrument is an indicator variable equal to one if the company is targeted by a shareholder who submits the same environment-related proposal to at least five companies in the same proxy season (*environmental activism wave*).[22] We then reestimate model (1) by two-stage least squares (2SLS), instrumenting *environmental shareholder activism* with *environmental activism wave* in the first stage.[23]

## 5 | RESULTS

### 5.1 | Shareholder activism and the voluntary disclosure of climate change risks

In Columns (1) and (2) of Table 2, we estimate our baseline specification in Equation (1) without and with controls. We find that environmental shareholder activism increases the voluntary disclosure of climate change risks. Specifically, the coefficient of

[22]In robustness checks described below, we show that our results are not sensitive to the five-company cutoff.

[23]Specifically, in the first-stage specification, we regress environmental shareholder activism on the instrument:
$$\textit{environmental shareholder activism}_{it} = a_i + a_t + b \times \textit{environmental activism wave}_{it} + \mathbf{c}'\mathbf{X_{it-1}} + e_{it}. \quad (2)$$
The predicted values from this regression provide *environmental shareholder activism (instrumented)*. In the second stage, we then reestimate Equation (1) using *environmental shareholder activism (instrumented)* in lieu of *environmental shareholder activism*:
$$\textit{disclosure of climate change risks}_{it} = \alpha_i + \alpha_t + \beta_{2SLS} \times \textit{environmental shareholder activism (instrumented)}_{it-1} + \boldsymbol{\gamma}'\mathbf{X_{it-1}} + \varepsilon_{it}. \quad (3)$$
*SE*s in the second stage are adjusted for the use of an estimated regressor from the first stage.

**TABLE 5** Shareholder-induced disclosure of climate change risks by type of shareholder

| | Disclosure of climate change risks$_t$ | |
|---|---|---|
| **Dependent variable** | **(1)** | **(2)** |
| Environmental shareholder activism by... | | |
| ... noninstitutional shareholders$_{t-1}$ | 0.062 (0.075) | 0.063 (0.075) |
| ... institutional shareholders$_{t-1}$ | 0.118 (0.047) | |
| ... institutional shareholders with long-term horizon$_{t-1}$ | | 0.151 (0.065) |
| ... institutional shareholders with short-term horizon$_{t-1}$ | | −0.011 (0.129) |
| ... institutional shareholders with unknown temporal horizon$_{t-1}$ | | 0.286 (0.189) |
| Size$_{t-1}$ | −0.201 (0.282) | −0.198 (0.283) |
| ROA$_{t-1}$ | 0.502 (1.626) | 0.590 (1.662) |
| Market-to-book$_{t-1}$ | 0.024 (0.021) | 0.024 (0.022) |
| Leverage$_{t-1}$ | 1.011 (0.559) | 1.046 (0.560) |
| Cash$_{t-1}$ | 1.450 (0.999) | 1.435 (0.975) |
| Firm fixed effects | Yes | Yes |
| Year fixed effects | Yes | Yes |
| Within *R*-squared | .13 | .14 |
| #Observations (firm-years) | 1,110 | 1,110 |
| #Firms | 265 | 265 |

*Note:* OLS estimates with *SE*s clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.
Abbreviations: OLS, ordinary least squares; ROA, *Return on assets*.

*environmental shareholder activism* is 0.101 ($SE = 0.043$, $p$-value = .043) with controls and 0.103 ($SE = 0.045$, $p$-value = .046) without controls. Since companies in our sample report an average of 2.2 climate change risks (see Table 1), the coefficients of 0.101–0.103 imply that companies increase their voluntary disclosure of climate change risks by 4.6–4.7% following the submission of an environment-related shareholder proposal.[24] These results lend support to Hypothesis (H1), predicting that environmental shareholder activism increases companies' voluntary disclosure of climate change risks.

## 5.2 | 2SLS analysis

In Table 3, we estimate the 2SLS specification described earlier, using *environmental activism wave* as instrument. As discussed above, if a shareholder targets companies in a wave, the targeting itself is plausibly exogenous with respect to a given individual company.

We reestimate the two specifications considered in Table 2 using 2SLS. The first-stage regressions are reported in Columns (1) and (2) of Table 3. The coefficient on the instrument

[24]In Online Appendix Table A3, we report similar results when including industry-by-year fixed effects, thereby accounting for any unobservable industry-specific trend (e.g., in terms of stakeholder dependence, exposure to climate change risks, stakeholder awareness towards ESG) that could affect both shareholder activism and the disclosure of climate risk information.

(*environmental activism wave*) is 0.911 (*SE* = 0.098, *p*-value = .000) and 0.913 (*SE* = 0.095, *p*-value = .000), respectively. Importantly, the instrument qualifies as "strong" in statistical terms; its *F*-statistic ranges from 85.6 to 91.9, well above the *F* = 10 threshold of Staiger and Stock (1997) and the critical values of Stock and Yogo (2005) for strong instruments.[25] The respective second-stage regressions are reported in Columns (3) and (4). The coefficient on *environmental shareholder activism (instrumented)* is 0.337 (*SE* = 0.148, *p*-value = .022) and 0.350 (*SE* = 0.126, *p*-value = .006), respectively. The 2SLS estimates are larger in magnitude than the OLS estimates.[26] Overall, the 2SLS analysis confirms that our results are unlikely to be driven by endogeneity bias.

## 5.3 | Types of voluntary climate change risk disclosure

To explore whether our results vary depending on what types of climate risk are disclosed, we reestimate our baseline specification, decomposing the dependent variable into three dummy variables indicating the disclosure of climate risk information pertaining to (a) regulatory risks, (b) physical risks, and (c) other risks.

The results, reported in Table 4, indicate that the voluntary disclosure of all three types of climate risk increases in response to environmental shareholder activism. All three point estimates are within the same ballpark (ranging from 0.028 to 0.039, with *SE*s from 0.014 to 0.019, and *p*-values from .022 to .098).[27]

## 5.4 | Shareholder pressure by shareholder type

To examine how the relationship between shareholder activism and climate risk disclosure varies depending on the type of shareholder who initiates the activism, we refine our baseline analysis by decomposing *environmental shareholder activism* by shareholder type.

### 5.4.1 | Institutional versus noninstitutional shareholders

In Column (1) of Table 5, we distinguish between environment-related shareholder proposals submitted by institutional versus noninstitutional shareholders. The coefficient for institutional shareholders (0.118, with *SE* = 0.047 and *p*-value = .034) is about 17% larger than our baseline estimate in Column (2) of Table 2, whereas the coefficient for noninstitutional investors (0.062, with *SE* = 0.075 and *p*-value = .429) is about 39% smaller than the baseline estimate.[28] These results are consistent with Hypothesis (H2), predicting that shareholder activism initiated by institutional investors is more effective in inducing the disclosure of climate risk information.

[25]Note that the predicted values lie within the range of values of the dependent variable in both specifications.
[26]The standard errors are larger as well, which is intuitive since we rely on a subset of the variation in environmental shareholder activism—namely, the variation triggered by the "wave" component of environmental shareholder activism—and hence we have less power in the regression.
[27]In Online Appendix Table A4, we report similar results when using logit regressions with conditional fixed effects.
[28]Note that, while the difference is large in economic terms, it is less pronounced in statistical terms. The *p*-value of the difference between the two coefficients is .498. In the corresponding 2SLS specification provided in Column (1) of Table 6, the *p*-value of the difference is .511.

**TABLE 6** Shareholder-induced disclosure of climate change risks by type of shareholder (2SLS)

| | Disclosure of climate change risks$_t$ | |
|---|---|---|
| **Dependent variable** | **(1)** | **(2)** |
| Environmental shareholder activism by... | | |
| ... noninstitutional shareholders (instr.)$_{t-1}$ | 0.115 (0.120) | 0.125 (0.131) |
| ... institutional shareholders (instr.)$_{t-1}$ | 0.203 (0.093) | |
| ... institutional shareholders with long-term horizon (instr.)$_{t-1}$ | | 0.329 (0.105) |
| ... institutional shareholders with short-term horizon (instr.)$_{t-1}$ | | −0.290 (0.117) |
| ... institutional shareholders with unknown temporal horizon (instr.)$_{t-1}$ | | −0.100 (0.081) |
| Size$_{t-1}$ | −0.194 (0.236) | −0.173 (0.224) |
| ROA$_{t-1}$ | 0.545 (1.375) | 0.817 (1.399) |
| Market-to-book$_{t-1}$ | 0.022 (0.018) | 0.021 (0.020) |
| Leverage$_{t-1}$ | 1.032 (0.495) | 1.120 (0.495) |
| Cash$_{t-1}$ | 1.451 (0.850) | 1.443 (0.795) |
| Firm fixed effects | Yes | Yes |
| Year fixed effects | Yes | Yes |
| *F*-statistics (instruments) | 32.37 | 15.47 |
| Within *R*-squared | .13 | .12 |
| #Observations (firm-years) | 1,110 | 1,110 |
| #Firms | 265 | 265 |

*Note:* 2SLS estimates with *SE*s clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.
Abbreviations: 2SLS, two-stage least squares; ROA, *Return on assets*.

### 5.4.2 | Long-term versus short-term institutional shareholders

In Column (2) of Table 5, we further distinguish between institutional shareholders with long- versus short-term horizons. For long-term institutional investors, the coefficient rises to 0.151 ($SE = 0.065$, $p$-value = .046), which is about 50% larger than our baseline estimate in Column (2) of Table 2, while the coefficient is close to zero for short-term institutional investors (coefficient of −0.011, with $SE = 0.129$ and $p$-value = .936).[29] This is consistent with Hypothesis (H3), predicting that shareholder activism initiated by long-term institutional investors is more effective in inducing the disclosure of climate risk information.

### 5.4.3 | 2SLS specification

In Table 6, we reestimate the regressions from Table 5, but using 2SLS in lieu of OLS. For each shareholder group, we construct the corresponding wave instrument (using the waves initiated by the respective shareholder group). Given the finer-grained nature of this analysis, we code

[29]The $p$-value of the difference between the two coefficients is .327. In the corresponding 2SLS specification provided in column (2) of Table 6, the $p$-value of the difference is .167.

**TABLE 7** Stock market response following shareholder-induced disclosure of climate change risks

| | CAR (%) | | |
|---|---|---|---|
| | **Market model (one-factor model) (1)** | **Fama–French (three-factor model) (2)** | **Fama–French–Momentum (four-factor model) (3)** |
| Main event windows | | | |
| [−10, 10] | 1.210 (0.371) | 0.938 (0.384) | 1.048 (0.392) |
| [−5, 5] | 0.460 (0.260) | 0.433 (0.254) | 0.536 (0.260) |
| Pre- and post-periods | | | |
| [−50, −11] | 0.391 (0.483) | −0.256 (0.447) | −0.266 (0.458) |
| [11, 50] | 0.444 (0.590) | 0.417 (0.630) | 0.510 (0.614) |

*Note:* This table reports the average CARs across all 248 events in which companies disclose climate risks following environmental shareholder activism. *SE*s are reported in parentheses. The event day (Day 0) is the day on which climate risk information is disclosed. CARs are computed using the market model, the three-factor model of Fama and French (1993), and the four-factor model of Carhart (1997), respectively.
Abbreviation: CAR, cumulative abnormal return.

each wave instrument on the basis of 3+ proposals—as opposed to 5+ in the baseline—to ensure that we have enough waves for each shareholder group.[30] The 2SLS estimates are similar to the OLS results, and continue to lend support to Hypotheses (H2) and (H3).

### 5.5 | Robustness

In Online Appendix A (and Tables A6–A9), we provide several robustness checks that are variants of the specifications in Column (2) of Table 2 (pertaining to Hypothesis (H1) and Columns (1)–(2) of Table 5 (pertaining to Hypotheses (H2) and (H3)), respectively. In a nutshell, we show that our results are robust (a) when we consider the dynamics of the relationship between environmental shareholder activism and climate risk disclosure; (b) if we extend the sample to firms targeted by SRI proposals during the sample period; (c) if we use a Poisson regression in lieu of OLS; (d) if we control for firm age and the firm's environmental, social, and governance (ESG) ratings; and (e) if we use alternative cutoffs (in terms of the number of proposals) for the wave instrument.

## 6 | IMPLICATIONS FOR VALUATION

Our results so far indicate that environmental shareholder activism induces companies to disclose climate risk information, thereby improving transparency and mitigating information asymmetries between firms and investors. In this section, we examine how the stock market responds to the (shareholder-induced) disclosure of climate risk information.

[30]In Online Appendix Table A5, we provide summary statistics for the wave instruments by shareholder groups. Not surprisingly, the bulk of the waves (about 90%) are initiated by institutional investors. Out of those, about 83% are initiated by long-term institutional investors.

Greater transparency about a firm's climate risk information may translate into higher valuation. Indeed, the argument that greater transparency brings about higher valuation has a long tradition in the accounting literature (for a survey, see Healy & Palepu, 2001). The rationale is intuitive—investors dislike uncertainty and are willing to pay a premium for less opaque companies. In this vein, greater transparency with respect to climate change risks can be valuable to investors, as it resolves uncertainty with regard to a potentially important source of risk.[31] Investors gain insights not only on the firm's assessment of its exposure to climate change risks but also—and perhaps more importantly—on the actual steps it is taking to manage and mitigate its exposure going forward.[32] From this perspective, the stock market may respond positively to the disclosure of climate risk information.

While transparency per se is positively valued by shareholders, the valuation response also depends on whether the disclosed climate risk information (i.e., the firm's exposure to climate change risks along with information on how the firm is managing those risks) is better or worse than what investors had anticipated—or simply put, whether the disclosed information is good or bad (unexpected) news. If the disclosed climate risk information is better than expected, investors will update their priors accordingly, which can amplify the positive valuation effect gained from greater transparency.

In contrast, if the disclosed climate risk information turns out to be worse than anticipated, this might dampen the positive valuation effect of greater transparency. Whether or not this will occur is ambiguous because there are two countervailing forces. On the one hand, investors will update upward their perception of the company's risk, which reduces the appeal of holding the company's stock. In fact, some investors (e.g., those that engage in "negative screening" practices) might even divest and reallocate their funds away from the disclosing companies to other companies with a less severe exposure to climate change risks and/or better risk mitigation plans.[33]

On the other hand, by disclosing (unfavorable) climate risk information, firms can convey to their investors that they are well aware of their vulnerability to climate change risks, and that they are taking actions to mitigate these risks. Furthermore, by doing so, they allow their investors to engage with them in a more informed fashion, advise them on how to best move forward in managing and mitigating the risk exposure, and strengthen the trust and relationship between investors and the disclosing company. As the survey by Krueger et al. (2020) suggests, this is likely positively valued by investors who prefer to actively engage with their portfolio companies in order to manage and minimize climate risks, as opposed to divesting from firms with high-risk exposure. Taken together, in situations where the disclosed climate risk exposure is more severe than anticipated, the net effect of these two countervailing forces need not be negative.

As these considerations illustrate, it is unclear how the stock market would respond, if at all, to the disclosure of climate change risks. In what follows, we examine this question

[31]This argument is in line with the findings of Ioannou and Serafeim (2019) and Krueger (2015a), who document higher valuations following the mandatory disclosure of nonfinancial information.

[32]For example, firms may report that they are diversifying their supplier base across regions to minimize disruptions in case of flooding and fierce storms. Or they may be shifting their product mix toward energy-efficient products to appeal to shifting consumer preferences, improve their reputation, and meet current or expected governmental climate policies. As these examples illustrate, resolving uncertainty about the firm's exposure to climate risks, and informing investors about the firm's efforts to manage and mitigate these risks, may be valuable to investors.

[33]"Negative screening" refers to those investors who exclude certain sectors or companies based on specific ESG criteria (e.g., tobacco or weapons manufacturing)—see, for example, Trinks and Scholtens (2017).

empirically. To do so, we focus on the subsample of companies that disclose climate risk information after being targeted by environmental shareholder activism.[34] We then conduct an event study that quantifies the stock market response in a short window around the day on which the climate risk information is disclosed to the public. We code the event day ("Day 0") as the day on which the CDP report is released for S&P 500 companies.[35]

In our main event window, denoted by [−10, 10], we include 10 days before and 10 days after the event day (i.e., 21 days in total). The inclusion of the preceding 10 days accounts for the possibility that information may have leaked to the market prior to the release of the CDP report; the inclusion of the subsequent 10 days accounts for the possibility that the stock market may underreact or overreact on the event day, and need a few days to properly reflect the disclosed information. Our choice of a [−10, 10] event window is guided by the finance literature that studies the stock market response to ESG-related events (e.g., Krueger, 2015b). For robustness, we also report the results in a shorter [−5, 5] event window.

Importantly, we also consider the [−50, −11] time window to assess potential pre-trends in stock prices (which would be symptomatic of omitted variables), and the [11, 51] time window to examine whether the stock market response is subsequently reversed. To the extent that the event study is well specified, one would not expect to find systematic patterns in stock returns several weeks before and after the events.

For each time window, we compute cumulative abnormal returns (CARs). Intuitively, abnormal returns capture stock returns in excess of the "normal" returns that are predicted by an asset pricing model. In the analysis, we use three different asset pricing models: (a) the market model, (b) the three-factor model of Fama and French (1993), and (c) the four-factor model of Carhart (1997). The CARs are then obtained by summing up the daily abnormal returns across all days during the relevant time interval. Online Appendix B describes in detail how CARs are computed.

The results are presented in Table 7. For each of the three asset pricing models, the table reports the average CAR across all events, along with their *SE*s. As can be seen, we find that stock prices increase by 0.94–1.21% during the [−10, 10] event window (with *SE*s ranging from 0.37 to 0.39, and *p*-values from .001 to .015), and by 0.43–0.54% during the [−5, 5] event window (with *SE*s ranging from 0.25 to 0.26, and *p*-values from .040 to .089). This indicates that the market responds positively to the (shareholder-induced) disclosure of climate risk information, assigning a higher valuation to these stocks. Moreover, we find no evidence for pre-trends (CARs are small in the [−51, −11] interval), nor do we find a reversal of the stock market response. If at all, CARs in the [11, 51] interval are positive, albeit small in economic terms. Overall, these estimates indicate that targeted companies achieve a higher stock market valuation postdisclosure, suggesting that investors value the (voluntary) disclosure of climate change risks.

Finally, we caution that the results in Table 7 need not warrant a causal interpretation. Indeed, while our results show that environmental shareholder activism triggers higher disclosure, and that higher disclosure is associated with a subsequent increase in valuation, higher disclosure per se need not *cause* higher valuation. For example, it could be that companies

[34]Formally, using the notation from equation (1), this corresponds to the subsample of 248 observations for which *environmental shareholder activism*$_{it\text{-}1}$ and *disclosure of climate change risks*$_{it}$ are both positive.

[35]This follows the methodology of Alsaifi, Elnahass, and Salama (2020) and Zamora-Ramirez and Gonzalez-Gonzalez (2015), who study how the stock market responds to the release of CDP reports for UK and Spanish companies, respectively.

disclosing climate risk information are primarily those with lower risk exposure (compared to the market's ex ante belief), which in turn could induce a positive stock market response. Addressing the latter is challenging, since (a) doing so would require a separate instrument for disclosure (in addition to the instrument for shareholder activism), and (b) one cannot observe the information that the management decided not to disclose.[36]

## 7 | DISCUSSION AND CONCLUSION

Can shareholder activism successfully induce firms to voluntarily disclose their exposure to climate change risks as well as their efforts to manage those risks? In this study, we shed light on this question and explore what types of shareholders are more effective in improving the voluntary disclosure of climate risk information. In addition, we examine how the stock market responds to such voluntary disclosure.

We find that companies are more likely to disclose climate risk information following environmental shareholder activism. Moreover, we find that environmental shareholder activism is especially effective if initiated by institutional investors, and even more so if initiated by long-term institutional investors. Finally, we find that companies that voluntarily disclose climate risk information following environmental shareholder activism achieve a higher stock market valuation postdisclosure, consistent with the notion that investors value the voluntary disclosure of climate risk information. Overall, our findings indicate that active shareholders can elicit greater climate risk disclosure, thereby improving the governance of their portfolio companies.

This study contributes to several strands of the literature. First, by showing that shareholder activism can elicit greater corporate transparency with respect to climate risks, and that companies achieve higher valuation following this (shareholder-induced) increase in transparency, we contribute to the literature on shareholder engagement (e.g., Aguilera, Bermejo, Capapé, & Cuñat, 2019; Dimson et al., 2015; Ferraro & Beunza, 2018; Gillan & Starks, 2000; Krueger et al., 2020). In particular, our study complements recent work on the value implications of the *mandatory* disclosure of nonfinancial information (e.g., Ioannou & Serafeim, 2019; Krueger, 2015a) by showing that—in absence of mandatory disclosure requirements—shareholder activism demanding the *voluntary* disclosure of *climate change risk information* has positive value implications, consistent with the notion that investors value the voluntary disclosure of the firm's exposure to climate change risks.

Second, we add to the literature that studies the voluntary disclosure of nonfinancial information. This literature focuses on the firms' *environmental performance* (as opposed to their *exposure* to climate risks) and mainly examines whether a firm discloses environmental information (such as greenhouse gas emissions) or participates in voluntary environmental initiatives (e.g., Jira & Toffel, 2013; Kim & Lyon, 2011a; Lewis et al., 2014; Lyon & Maxwell, 2011; Reid & Toffel, 2009). Our data allow us to go deeper: we explore how much and what type of environmental information—and more specifically what type of climate risk information—is disclosed.

[36]In Online Appendix Table A10, we redo the above analysis focusing on firms that disclose climate risk information but were not targeted by environmental shareholder activism. Interestingly, the results mirror those in Table 7, suggesting that the disclosure of climate change risks is valued by the stock market regardless of what initiates the disclosure.

More broadly, the disclosure of climate risk information has received surprisingly little attention in the academic literature.[37] Yet, it is a key concern for investors (e.g., Financial Times, 2018; Krueger et al., 2020). For example, in the aforementioned survey by Krueger et al. (2020), the majority of investors responded that climate risk reporting is as important as financial reporting, and about one-third reported that climate risk reporting is even more important. Accordingly—while this article provides a first step in this direction—more research is needed to shed light on the determinants and implications of the (voluntary) disclosure of climate risks. Making ground on these questions is both a promising and important avenue for future research.

Third, this study adds to the strategy and management literature by taking a finer-grained view at shareholders and their influence on corporate behavior. The existing literature that studies how shareholders help shape corporate behavior—for example, Chen and Feldman (2019), David, Hitt, and Gimeno (2001), Lenox and Eesley (2009), Reid and Toffel (2009)—typically (a) considers shareholders as one homogenous group (instead of distinguishing between different types of shareholders), or (b) only considers one specific subset of shareholders (such as hedge funds). Yet, there are considerable differences among shareholders (e.g., in terms of their time horizons, preferences, and objectives), and these differences are likely to have important implications for their interactions with their companies. In this study, we account for the heterogeneity among shareholder types and examine how these differences influence corporate behavior (in the specific context of shareholders' ability to elicit greater corporate transparency). As such, our findings add to the small but burgeoning literature that highlights the importance of distinguishing between different types of shareholders in strategy and management research (e.g., Connelly, Shi, Hoskisson, & Koka, 2019; Hoskisson, Hitt, Johnson, & Grossman, 2002; Tihanyi, Johnson, Hoskisson, & Hitt, 2003).

Our findings have important implications for practice, as they highlight the ability of investors to elicit greater corporate transparency with respect to climate change risks—even in the absence of mandatory disclosure requirements—and thus contribute to their portfolio companies' governance. In absence of mandatory disclosure requirements imposed by the government, this greater ability also implies that investors (particularly, long-term institutional investors) have a greater responsibility to be *active* owners and engage with management to elicit the disclosure of climate change risks.

On this note, we caution that, while our results indicate that private governance (in the form of shareholder activism) is effective in eliciting the disclosure of climate change risks, it is unlikely to substitute for public governance (Ho, 2018; Light & Orts, 2015; Vandenberg, 2013). Indeed—and this is speculative—the latter might be more effective in (a) improving the quantity and quality of disclosure, (b) fostering standardization of disclosure (thereby facilitating investors' assessments of their portfolio companies), and (c) ultimately making progress in the fight against climate change. Long-term institutional investors may therefore find it worthwhile to both pursue shareholder activism and engage with the government to mandate climate change risk disclosure. Understanding how to effectively engage with companies and governments to induce greater climate risk disclosure—and what the optimal combination of these engagements is—is fertile ground for future research.

[37]A firm's exposure to climate change risks is very different from a firm's environmental footprint. Firms across industries—whether emission-intensive or not—are exposed to climate change risks. As previously mentioned, climate change risks involve the threat of damage, injury, liability, loss, or any other harm to the company that is caused by climate-related events. They include physical risks, regulatory risks, and other climate-related risks.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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**ONLINE APPENDIX FOR**

# SHAREHOLDER ACTIVISM AND FIRMS' VOLUNTARY DISCLOSURE OF CLIMATE CHANGE RISKS

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**ONLINE APPENDIX**

**Appendix A. Additional robustness tests**

Table A6 and A7 provide a series of robustness checks that are variants of the specification in column (2) of Table 2 (henceforth "baseline specification").

*Dynamics.* In column (1) of Table A6, we examine the dynamics to rule out reverse causality concerns. Specifically, we augment our baseline specification in equation (1) by including leads and lags of *environmental shareholder activism* (in addition to the *t*–1 term used in the baseline). The only sizable coefficient is the one on the *t*–1 term (0.114, with SE = 0.044 and *p*-value = 0.030), which is about 13% larger than our baseline estimate of 0.101 in column (2) of Table 2; all other coefficients are smaller, ranging from -0.002 to 0.060, with SEs ranging from 0.038 to 0.066 and *p*-values from 0.221 to 0.975. This confirms that environmental shareholder activism leads to subsequent increases in the voluntary disclosure of climate change risks—not the other way around—and that it takes about one year after the shareholder activism for the higher disclosure to materialize.

*External validity.* In our baseline analysis, the sample is restricted to firms targeted by SRI proposals during the sample period. This criterion ensures that the comparison firms (i.e., the "control" group) face similar exposure to SRI-related shareholder activism. In column (2) of Table A6, we relax this criterion, extending the sample to all firms in the ISS and CDP databases that are targeted by *any* type of shareholder proposal during the sample period. For each of these 346 firms, we now include the years within 2010–2016 that range from its earliest shareholder proposal of any type through its most recent proposal, yielding a sample of 1,631 firm-years ("ISS sample"). Our main results continue to hold in this broader sample, indicating that our findings are generalizable to the broader set of companies with active shareholders.

*Functional form.* In our regressions, the dependent variable—*disclosure of climate change risks*—is a count variable that ranges from 0 to 3. In column (3) of Table A6, we re-estimate our baseline specification using a Poisson regression in lieu of OLS.[1] The point estimate is 0.043 (SE = 0.015, *p*-value = 0.004), which mirrors what we obtained in the baseline OLS specification.

*Alternative definition of environmental activism waves.* In our main 2SLS approach, we coded waves based on a five-company threshold; that is, to qualify as a wave, the submitting shareholder needs to target at least five companies with the same proposal in the same proxy season. The threshold level seeks to balance two considerations. On one hand, the threshold needs to be sufficiently high such that the notion of "wave" is meaningful. On the other hand, too high a threshold reduces the number of waves and hence the power of the instrument. In columns (4) and (5) of Table A6, we re-estimate our 2SLS regression using a four- and six-company threshold, respectively, and find that our results are robust.

*Additional controls*. In Table A7, we expand the set of control variables. In column (1), we include *log(age)*, where *age* is the number of years since the company has been covered in Compustat. Controlling for age accounts for the possibility that older firms might be better able to resist shareholder pressure. In column (2), we include ESG ratings from Thomson Reuters' ASSET4—specifically, the *environmental score*, *social score*, and *governance score* (each of them is measured by ASSET4 on a 0–100 scale)—to account for the possibility that ESG factors may confound the relationship between environmental shareholder activism and the disclosure of climate risk information.[2] In column (3), we include both *log(age)* and the ESG ratings in the same

[1] We use a Poisson (in lieu of a negative binomial) regression for this robustness test because our dependent variable (*disclosure of climate change risks)* has a variance of 1.35 and mean of 2.21, and hence does not exhibit overdispersion.

[2] Note that the sample decreases from 1,110 to 976 firm-year observations due to the more restrictive coverage of ASSET4.

regression. As can be seen, our results are virtually unaffected by the inclusion of these additional controls.

*Environmental shareholder activism by shareholder type*. In Tables A8 and A9, we repeat the robustness checks described above, but with respect to the specifications in columns (1) and (2) of Table 5, where environmental shareholder activism is decomposed by shareholder type. As can be seen, we find that our results continue to hold—that is, shareholder activism initiated by institutional investors (odd-numbered columns in Tables A8 and A9), and especially institutional investors with a long-term horizon (even-numbered columns), is more effective in inducing the disclosure of climate risk information.

**Appendix B. Calculation of cumulative abnormal returns**

*Market model*

We first describe how we use the market model to compute cumulative abnormal returns in several time intervals around the event day. The event day (day 0) refers to the day in which the climate risk information is disclosed to the public. The intervals we consider are [-50, -11], [-10, 10], and [11, 50]. For each firm, the coefficients of the market model are estimated by OLS using daily stock return data from the Center for Research in Security Prices (CRSP) database in the 200 trading days that precede the first time interval (i.e., the 200 trading days used in the estimation correspond to the [-250, -51] interval). Specifically, we estimate the following regression:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \varepsilon_{it} \ ,$$

where $R_{it}$ is the stock return of company $i$ on day $t$, $R_{mt}$ is the return of the equally weighted CRSP market portfolio on day $t$, and $\varepsilon_{it}$ *is* the residual. Using the OLS estimates of $\alpha_i$ and $\beta_i$, we can compute the predicted ("normal") daily returns as

$$\hat{R}_{it} = \alpha_i + \beta_i \times R_{mt} \ .$$

The daily abnormal normal (AR) is then obtained as

$$AR_{it} = R_{it} - \hat{R}_{it} \ .$$

Finally, the cumulative abnormal return (CAR) is computed by adding up the daily abnormal returns across all days within the relevant time window (e.g., [-10, 10]).

*Multi-factor models*

The market model is a one-factor model in which the sole factor is the market return ($R_{mt}$). As alternatives to the market model, we also compute abnormal returns using the three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997). The procedure is the same

as above, except that a different regression specification is used to compute abnormal returns. In the three-factor model, the underlying regression is

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \gamma_i \times SMB_t + \delta_i \times HML_t + \varepsilon_{it} ,$$

where *SMB* ("small minus big") is the size factor and *HML* ("high minus low") is the book-to-market factor. In the four-factor model, the regression is

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \gamma_i \times SMB_t + \delta_i \times HML_t + \theta_i \times UMD_t + \varepsilon_{it} ,$$

where *UMD* ("up minus down") is the momentum factor. The daily data on the *SML*, *HML*, and *UMD* factors are obtained from Kenneth French's website.

## Appendix tables

### Table A1. Disclosure of climate change risks and environmental shareholder activism by industry

| | | Disclosure of climate change risks | | | | Environmental shareholder activism | | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. dev. | Min | Max | Mean | Std. dev. | Min | Max |
| Agriculture, forestry, and fishing | 7 | 2.14 | 1.46 | 0 | 3 | 1.00 | 0.82 | 0 | 2 |
| Construction | 2 | 3.00 | 0.00 | 3 | 3 | 0.00 | 0.00 | 0 | 0 |
| Finance, insurance, and real estate | 191 | 1.95 | 1.20 | 0 | 3 | 0.13 | 0.35 | 0 | 2 |
| Manufacturing | 412 | 2.39 | 1.07 | 0 | 3 | 0.37 | 0.81 | 0 | 5 |
| Mining | 72 | 2.42 | 0.82 | 1 | 3 | 0.61 | 0.85 | 0 | 4 |
| Retail trade | 116 | 1.83 | 1.33 | 0 | 3 | 0.53 | 0.67 | 0 | 2 |
| Services | 84 | 2.21 | 1.17 | 0 | 3 | 0.20 | 0.46 | 0 | 2 |
| Utilities | 197 | 2.34 | 1.12 | 0 | 3 | 0.30 | 0.59 | 0 | 3 |
| Wholesale trade | 16 | 1.94 | 1.24 | 0 | 3 | 0.25 | 0.45 | 0 | 1 |
| Nonclassifiable | 13 | 0.69 | 1.32 | 0 | 3 | 0.62 | 0.65 | 0 | 2 |
| All | 1,110 | 2.21 | 1.16 | 0 | 3 | 0.34 | 0.68 | 0 | 5 |

*Notes.* N refers to the number of firm-year observations. Industries are partitioned according to SIC divisions. The SIC divisions (and the corresponding 2-digit SIC codes) are as follows: agriculture, forestry and fishing (SIC 00-09); mining (SIC 10-14); construction (SIC 15-19); manufacturing (SIC 20-39); utilities (SIC 40-49); wholesale trade (SIC 50-51); retail trade (SIC 52-59); finance, insurance, and real estate (SIC 60-69); services (SIC 70-89); public administration (SIC 90-98, not represented in our sample); and non-classifiable industries (SIC 99).

**Table A2. Disclosure of climate change risks and environmental shareholder activism by year**

| | | Disclosure of climate change risks | | | | Environmental shareholder activism | | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. dev. | Min | Max | Mean | Std. dev. | Min | Max |
| 2010 | 167 | 1.77 | 1.28 | 0 | 3 | 0.28 | 0.71 | 0 | 5 |
| 2011 | 174 | 2.06 | 1.25 | 0 | 3 | 0.30 | 0.66 | 0 | 4 |
| 2012 | 171 | 2.17 | 1.19 | 0 | 3 | 0.26 | 0.58 | 0 | 4 |
| 2013 | 175 | 2.27 | 1.12 | 0 | 3 | 0.31 | 0.69 | 0 | 5 |
| 2014 | 165 | 2.33 | 1.07 | 0 | 3 | 0.42 | 0.72 | 0 | 4 |
| 2015 | 145 | 2.42 | 1.02 | 0 | 3 | 0.43 | 0.72 | 0 | 4 |
| 2016 | 113 | 2.56 | 0.94 | 0 | 3 | 0.42 | 0.69 | 0 | 2 |
| All | 1,110 | 2.21 | 1.16 | 0 | 3 | 0.34 | 0.68 | 0 | 5 |

*Notes.* N refers to the number of firm-year observations.

**Table A3. Shareholder-induced disclosure of climate change risks, accounting for industry-specific time trends**

| Dependent variable: | Disclosure of climate change risks$_t$ |
|---|---|
| | (1) |
| Environmental shareholder activism$_{t-1}$ | 0.078 |
| | (0.040) |
| Size$_{t-1}$ | -0.316 |
| | (0.265) |
| ROA$_{t-1}$ | -0.457 |
| | (1.770) |
| Market-to-book$_{t-1}$ | 0.018 |
| | (0.026) |
| Leverage$_{t-1}$ | 0.838 |
| | (0.569) |
| Cash$_{t-1}$ | 1.449 |
| | (0.939) |
| Firm fixed effects | Yes |
| Industry × year fixed effects | Yes |
| Within R-squared | 0.23 |
| # Observations (firm-years) | 1,110 |
| # Firms | 265 |

*Notes.* OLS estimates with standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.

**Table A4. Shareholder-induced disclosure of various types of climate change risks, estimated via logit regressions with conditional fixed effects**

| Dependent variable: | Disclosure of regulatory climate change risks$_t$ | Disclosure of physical climate change risks$_t$ | Disclosure of other climate change risks$_t$ |
|---|---|---|---|
| | (1) | (2) | (3) |
| Environmental shareholder activism$_{t-1}$ | 0.632 | 0.796 | 0.315 |
| | (0.272) | (0.253) | (0.233) |
| Size$_{t-1}$ | 1.217 | -0.944 | -0.063 |
| | (2.850) | (2.588) | (1.354) |
| ROA$_{t-1}$ | -3.064 | 16.516 | 1.661 |
| | (16.616) | (9.124) | (8.972) |
| Market-to-book$_{t-1}$ | 0.378 | 0.181 | 0.226 |
| | (0.233) | (0.204) | (0.253) |
| Leverage$_{t-1}$ | 14.774 | 8.619 | 4.782 |
| | (5.591) | (4.384) | (3.944) |
| Cash$_{t-1}$ | 8.149 | 10.652 | 7.828 |
| | (2.948) | (5.273) | (4.246) |
| Firm fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Pseudo R-squared | 0.40 | 0.49 | 0.23 |
| # Observations (firm-years) | 306 | 317 | 360 |

*Notes.* Estimates from logit regressions with conditional fixed effects (log-odds ratios) with standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions.

**Table A5. Waves of environmental shareholder activism by type of shareholder**

| | N | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| Waves of 3+ proposals | 1,110 | 0.078 | 0.269 | 0 | 1 |
| Waves of 3+ proposals initiated by institutional investors | 1,110 | 0.070 | 0.256 | 0 | 1 |
| Waves of 3+ proposals initiated by non-institutional investors | 1,110 | 0.008 | 0.090 | 0 | 1 |
| Waves of 3+ proposals initiated by long-term institutional investors | 1,110 | 0.058 | 0.233 | 0 | 1 |
| Waves of 3+ proposals initiated by short-term institutional investors | 1,110 | 0.014 | 0.116 | 0 | 1 |
| Waves of 3+ proposals initiated by institutional investors with unknown temporal horizon | 1,110 | 0.001 | 0.030 | 0 | 1 |

## Table A6. Shareholder-induced disclosure of climate change risks: Robustness

| Dependent variable: | Disclosure of climate change risks$_t$ | | | | |
|---|---|---|---|---|---|
| | Dynamics | Broader ISS sample | Poisson regression | 2SLS – Activism wave based on 4+ proposals | 2SLS – Activism wave based on 6+ proposals |
| | (1) | (2) | (3) | (4) | (5) |
| Environmental shareholder activism$_{t+1}$ | -0.002 | | | | |
| | (0.066) | | | | |
| Environmental shareholder activism$_t$ | 0.060 | | | | |
| | (0.064) | | | | |
| Environmental shareholder activism$_{t-1}$ | 0.114 | 0.064 | 0.043 | | |
| | (0.044) | (0.032) | (0.015) | | |
| Environmental shareholder activism$_{t-2}$ | 0.050 | | | | |
| | (0.038) | | | | |
| Environmental shareholder activism (instr.)$_{t-1}$ | | | | 0.235 | 0.331 |
| | | | | (0.053) | (0.195) |
| Size$_{t-1}$ | -0.332 | -0.058 | -0.088 | -0.201 | -0.197 |
| | (0.306) | (0.205) | (0.117) | (0.237) | (0.226) |
| ROA$_{t-1}$ | -0.735 | -0.402 | 0.345 | 0.515 | 0.547 |
| | (2.032) | (1.572) | (0.621) | (1.413) | (1.372) |
| Market-to-book$_{t-1}$ | 0.033 | 0.012 | 0.012 | 0.022 | 0.021 |
| | (0.019) | (0.009) | (0.007) | (0.019) | (0.017) |
| Leverage$_{t-1}$ | 0.809 | 0.916 | 0.391 | 1.006 | 1.018 |
| | (0.534) | (0.526) | (0.216) | (0.465) | (0.467) |
| Cash$_{t-1}$ | 1.504 | 0.770 | 0.794 | 1.439 | 1.436 |
| | (0.918) | (0.917) | (0.450) | (0.841) | (0.837) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Within R-squared | 0.13 | 0.14 | – | 0.12 | 0.11 |
| # Observations (firm-years) | 997 | 1,631 | 1,110 | 1,110 | 1,110 |
| # Firms | 254 | 346 | 265 | 265 | 265 |

*Notes.* OLS estimates in columns (1) and (2); Poisson estimates in column (3); and 2SLS estimates in columns (4) and (5). Standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions. The sample is smaller in column (1) because this specification includes one-year forward and two-year lagged values of *environmental shareholder activism*, which excludes some observations.

**Table A7. Shareholder-induced disclosure of climate change risks: Robustness (continued)**

| Dependent variable: | Disclosure of climate change risks$_t$ | | |
|---|---|---|---|
| | Controlling for age | Controlling for ESG scores | Controlling for age and ESG scores |
| | (1) | (2) | (3) |
| Environmental shareholder activism$_{t-1}$ | 0.102 | 0.107 | 0.105 |
| | (0.043) | (0.053) | (0.051) |
| Size$_{t-1}$ | -0.203 | -0.290 | -0.295 |
| | (0.279) | (0.397) | (0.385) |
| ROA$_{t-1}$ | 0.503 | 0.635 | 0.609 |
| | (1.585) | (1.680) | (1.639) |
| Market-to-book$_{t-1}$ | 0.023 | 0.027 | 0.030 |
| | (0.020) | (0.017) | (0.018) |
| Leverage$_{t-1}$ | 1.021 | 0.996 | 0.962 |
| | (0.534) | (0.564) | (0.527) |
| Cash$_{t-1}$ | 1.446 | 1.281 | 1.271 |
| | (0.981) | (1.015) | (1.014) |
| Log(age)$_{t-1}$ | -0.186 | | 0.228 |
| | (0.321) | | (0.605) |
| ASSET4 Environmental score$_{t-1}$ | | 0.026 | 0.031 |
| | | (0.254) | (0.254) |
| ASSET4 Social score$_{t-1}$ | | 0.310 | 0.307 |
| | | (0.232) | (0.235) |
| ASSET4 Governance score$_{t-1}$ | | -0.243 | -0.271 |
| | | (0.562) | (0.552) |
| Firm fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |
| Within R-squared | 0.13 | 0.14 | 0.14 |
| # Observations (firm-years) | 1,110 | 976 | 976 |
| # Firms | 265 | 230 | 230 |

*Notes.* OLS estimates with standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions. The coefficients and standard errors of *ASSET4 environmental score*, *ASSET4 social score*, and *ASSET4 governance score* are multiplied by 100 for ease of exposition. The sample is smaller in columns (2) and (3) due to the more restrictive coverage of Thomson Reuters' ASSET4.

## Table A8. Shareholder-induced disclosure of climate change risks by type of shareholder: Robustness

| Dependent variable: | Disclosure of climate change risks$_t$ | | | | | |
|---|---|---|---|---|---|---|
| | Dynamics | | Broader ISS sample | | Poisson regression | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Environmental shareholder activism by… | | | | | | |
| … non-institutional shareholders$_{t+1}$ | 0.024 | 0.024 | | | | |
| | (0.083) | (0.096) | | | | |
| … non-institutional shareholders$_t$ | 0.010 | 0.014 | | | | |
| | (0.102) | (0.104) | | | | |
| … non-institutional shareholders$_{t-1}$ | 0.052 | 0.057 | 0.022 | 0.022 | 0.027 | 0.027 |
| | (0.080) | (0.084) | (0.059) | (0.059) | (0.030) | (0.030) |
| … non-institutional shareholders$_{t-2}$ | -0.009 | 0.001 | | | | |
| | (0.071) | (0.048) | | | | |
| … institutional shareholders$_{t+1}$ | -0.004 | | | | | |
| | (0.073) | | | | | |
| … institutional shareholders$_t$ | 0.090 | | | | | |
| | (0.067) | | | | | |
| … institutional shareholders$_{t-1}$ | 0.136 | | 0.082 | | 0.052 | |
| | (0.058) | | (0.032) | | (0.018) | |
| … institutional shareholders$_{t-2}$ | 0.087 | | | | | |
| | (0.066) | | | | | |
| … institutional shareholders with long-term horizon$_{t+1}$ | | 0.020 | | | | |
| | | (0.117) | | | | |
| … institutional shareholders with long-term horizon$_t$ | | 0.181 | | | | |
| | | (0.104) | | | | |
| … institutional shareholders with long-term horizon$_{t-1}$ | | 0.158 | | 0.136 | | 0.067 |
| | | (0.083) | | (0.052) | | (0.028) |
| … institutional shareholders with long-term horizon$_{t-2}$ | | 0.051 | | | | |
| | | (0.075) | | | | |
| … institutional shareholders with short-term horizon$_{t+1}$ | | -0.102 | | | | |
| | | (0.127) | | | | |
| … institutional shareholders with short-term horizon$_t$ | | -0.208 | | | | |
| | | (0.125) | | | | |
| … institutional shareholders with short-term horizon$_{t-1}$ | | 0.029 | | -0.078 | | -0.015 |
| | | (0.153) | | (0.077) | | (0.057) |
| … institutional shareholders with short-term horizon$_{t-2}$ | | -0.069 | | | | |
| | | (0.084) | | | | |
| … institutional shareholders with unknown temporal horizon$_{t+1}$ | | -0.286 | | | | |
| | | (0.222) | | | | |
| … institutional shareholders with unknown temporal horizon$_t$ | | -0.035 | | | | |
| | | (0.241) | | | | |
| … institutional shareholders with unknown temporal horizon$_{t-1}$ | | 0.082 | | 0.174 | | 0.123 |
| | | (0.240) | | (0.164) | | (0.077) |
| … institutional shareholders with unknown temporal horizon$_{t-2}$ | | 0.148 | | | | |
| | | (0.157) | | | | |
| Size$_{t-1}$ | -0.317 | -0.266 | -0.054 | -0.049 | -0.084 | -0.084 |
| | (0.304) | (0.339) | (0.204) | (0.199) | (0.120) | (0.121) |
| ROA$_{t-1}$ | -0.617 | -0.417 | -0.374 | -0.310 | 0.366 | 0.421 |
| | (2.016) | (2.197) | (1.571) | (1.567) | (0.633) | (0.676) |
| Market-to-book$_{t-1}$ | 0.031 | 0.038 | 0.012 | 0.012 | 0.012 | 0.012 |
| | (0.019) | (0.018) | (0.009) | (0.010) | (0.007) | (0.007) |
| Leverage$_{t-1}$ | 0.909 | 0.954 | 0.927 | 0.968 | 0.402 | 0.431 |
| | (0.504) | (0.516) | (0.523) | (0.529) | (0.219) | (0.222) |
| Cash$_{t-1}$ | 1.468 | 1.517 | 0.780 | 0.778 | 0.795 | 0.785 |
| | (0.902) | (0.887) | (0.919) | (0.905) | (0.455) | (0.444) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Within R-squared | 0.14 | 0.15 | 0.14 | 0.14 | – | – |
| # Observations (firm-years) | 997 | 997 | 1,631 | 1,631 | 1,110 | 1,110 |
| # Firms | 254 | 254 | 346 | 346 | 265 | 265 |

*Notes.* OLS estimates in columns (1)-(4); and Poisson estimates in column (5) and (6). Standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions. The sample is smaller in columns (1)-(2) because those specifications includes one-year forward and two-year lagged variables, which excludes some observations.

**Table A9. Shareholder-induced disclosure of climate change risks by type of shareholder: Robustness (continued)**

| Dependent variable: | Disclosure of climate change risks$_t$ | | | | | |
|---|---|---|---|---|---|---|
| | Controlling for age | | Controlling for ESG scores | | Controlling for age and ESG scores | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Environmental shareholder activism by… | | | | | | |
| … non-institutional shareholders$_{t-1}$ | 0.065 | 0.065 | 0.084 | 0.084 | 0.080 | 0.080 |
| | (0.076) | (0.076) | (0.076) | (0.077) | (0.080) | (0.081) |
| … institutional shareholders$_{t-1}$ | 0.118 | | 0.116 | | 0.115 | |
| | (0.047) | | (0.061) | | (0.059) | |
| … institutional shareholders with long-term horizon$_{t-1}$ | | 0.152 | | 0.158 | | 0.157 |
| | | (0.065) | | (0.078) | | (0.076) |
| … institutional shareholders with short-term horizon$_{t-1}$ | | -0.010 | | -0.051 | | -0.052 |
| | | (0.130) | | (0.184) | | (0.184) |
| … institutional shareholders with unknown temporal horizon$_{t-1}$ | | 0.286 | | 0.318 | | 0.319 |
| | | (0.191) | | (0.203) | | (0.199) |
| Size$_{t-1}$ | -0.198 | -0.196 | -0.289 | -0.286 | -0.294 | -0.291 |
| | (0.281) | (0.281) | (0.397) | (0.397) | (0.385) | (0.384) |
| ROA$_{t-1}$ | 0.531 | 0.618 | 0.652 | 0.768 | 0.626 | 0.741 |
| | (1.594) | (1.628) | (1.700) | (1.750) | (1.658) | (1.708) |
| Market-to-book$_{t-1}$ | 0.022 | 0.023 | 0.027 | 0.028 | 0.030 | 0.031 |
| | (0.021) | (0.021) | (0.017) | (0.017) | (0.018) | (0.017) |
| Leverage$_{t-1}$ | 1.039 | 1.074 | 1.012 | 1.062 | 0.977 | 1.027 |
| | (0.541) | (0.539) | (0.580) | (0.581) | (0.538) | (0.537) |
| Cash$_{t-1}$ | 1.453 | 1.438 | 1.281 | 1.258 | 1.271 | 1.248 |
| | (0.991) | (0.967) | (1.018) | (0.994) | (1.018) | (0.994) |
| Log(age)$_{t-1}$ | -0.173 | -0.168 | | | 0.236 | 0.242 |
| | (0.328) | (0.330) | | | (0.625) | (0.627) |
| ASSET4 Environmental score$_{t-1}$ | | | 0.025 | 0.022 | 0.029 | 0.027 |
| | | | (0.253) | (0.244) | (0.253) | (0.243) |
| ASSET4 Social score$_{t-1}$ | | | 0.312 | 0.308 | 0.309 | 0.306 |
| | | | (0.233) | (0.226) | (0.237) | (0.229) |
| ASSET4 Governance score$_{t-1}$ | | | -0.235 | -0.234 | -0.264 | -0.263 |
| | | | (0.564) | (0.559) | (0.552) | (0.546) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Within R-squared | 0.13 | 0.14 | 0.14 | 0.15 | 0.14 | 0.15 |
| # Observations (firm-years) | 1,110 | 1,110 | 976 | 976 | 976 | 976 |
| # Firms | 265 | 265 | 230 | 230 | 230 | 230 |

*Notes.* OLS estimates with standard errors clustered at the industry level in parentheses. Industries are partitioned according to SIC divisions. The coefficients and standard errors of *ASSET4 environmental score*, *ASSET4 social score*, and *ASSET4 governance score* are multiplied by 100 for ease of exposition. The sample is smaller in columns (2)-(6) due to the more restrictive coverage of Thomson Reuters' ASSET4.

**Table A10. Stock market response following non-shareholder-induced disclosure of climate change risks**

| | CAR (%) | | |
|---|---|---|---|
| | Market model (1-factor model) | Fama-French (3-factor model) | Fama-French-Momentum (4-factor model) |
| | (1) | (2) | (3) |
| Main event windows | | | |
| [-10, 10] | 0.995 | 0.938 | 0.920 |
| | (0.260) | (0.260) | (0.267) |
| [-5, 5] | 0.406 | 0.430 | 0.443 |
| | (0.188) | (0.181) | (0.182) |
| Pre- and post-periods | | | |
| [-50, -11] | -0.231 | -0.545 | -0.549 |
| | (0.343) | (0.342) | (0.342) |
| [11, 50] | 0.353 | 0.566 | 0.342 |
| | (0.365) | (0.363) | (0.359) |

*Notes.* This table reports the average cumulative abnormal returns (CARs) across all 670 events in which companies disclosed climate risks without previous environmental shareholder activism. Standard errors are reported in parentheses. The event day (day 0) is the day on which climate risk information is disclosed. CARs are computed using the market model, the three-factor model of Fama and French (1993), and the four-factor model of Carhart (1997), respectively.