Does Talking the Climate Change Talk Affect Firm Value? Evidence from the Paris Agreement

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ABSTRACT

We examine whether firms' voluntary climate disclosure affects the stock market's reaction to climate change policy. Using the Paris Agreement as an exogenous shock to climate policy and novel measures of climate-related disclosure developed in recent literature, we find that high-carbon emission firms with greater discussion of climate change exposure in conference calls *prior* to the Agreement experience less negative market reaction around the announcement. We further find that the positive disclosure effect is driven primarily by discussions of climate-related opportunities (e.g., investment in renewable energy) and is stronger for firms located in states with more stringent environmental regulations. This effect holds even when the discussions are accompanied with risk statements or negative tones. Taken together, our findings suggest that for firms that are most prone to regulatory scrutiny, investors do not perceive ex ante climate disclosures as greenwashing or cheap talk, but rather as positive signals about these firms' climate change preparedness and their ability to navigate future regulations.

Keywords: Climate change, climate-related disclosure, climate-related opportunities, voluntary disclosure, firm value, greenhouse gas emissions, Paris Agreement, greenwashing

1. Introduction

With the increasing frequency and severity of climate events, combating climate change has become a central priority for regulators and policy makers across the globe. A key issue at the top of the agenda is climate-related disclosure. In the U.S., the Securities and Exchange Commission (SEC) has issued guidance regarding climate disclosure for over a decade but has stopped short of making it mandatory. In March 2022, the SEC proposed a broad set of rules that would require companies to provide more consistent, comparable, and reliable disclosure about climate-related risks (SEC, 2022). [1] Yet despite the decade-long discussion on climate change reporting and a growing stream of research on climate disclosure,[2] we know little about whether or when investors incorporate qualitative information from climate disclosure into their expectations or about the nature of information that may be useful to investors. In this study we exploit the 2015 Paris Agreement as an exogenous shock to climate change policy to examine whether the market perceives firms' ex ante climate-related discussions in conference calls as informative in assessing the impact of policy news on firm value.[3]

Ex ante, whether greater climate disclosure should help investors better assess the effect of policy shocks on firm value is unclear for at least two reasons. First, evidence from recent research suggests that firms have incentives to engage in greenwashing, that is, to communicate an overly

[1] The proposed rules would require registrants to provide certain climate-related information in their registration statements and annual reports. The SEC's overarching goal is to mandate more consistent, comparable, and reliable disclosures that allow investors to "make informed judgments about the impact of climate-related risks on current and potential investments" (SEC, 2022). The proposed rules, however, are subject to ongoing debate. Critics question whether disclosure under the proposed rules will serve the intended purpose as well as whether the SEC has the authority to mandate climate disclosure (Cunningham, 2022). We provide a brief summary of the debate in Section 2.
[2] For instance, one branch of research examines the motivation for and impact of climate-related disclosures (e.g., Kim and Lyon, 2011; Matsumura et al., 2014). Another branch develops novel measures for firm-level climate disclosures (e.g., Sautner et al., 2021; Nagar and Schoenfeld, 2022). See Section 2 for a review of the literature.
[3] The Agreement set an initial path toward decarbonizing the economy by *i*) targeting a limit of 2° Celsius aggregate temperature increase over pre-industrial levels by the end of the 21st century, and *ii*) requiring signatory countries to submit their plans for reducing greenhouse gas (GHG) emissions. See Section 2 for a more detailed discussion.

positive environmental performance (e.g., Crilly et al., 2016; Fabrizio and Kim, 2019; Hail et al., 2022). Hence, investors may view the disclosure as cheap talk and discount (or ignore) the disclosed information. Second, unlike other types of firm-specific disclosure, climate disclosure is related to events that are inherently less predictable. Hence, many firms struggle to obtain a clear assessment of their climate exposure, which reduces their ability to provide external stakeholders reliable information on such exposure (Barnett, Brock, and Hansen, 2020). Even if the disclosed information is informative, whether the market perceives such information as a positive or a negative signal is also unclear ex ante. On the one hand, investors may view greater climate disclosure as a positive signal about a company's climate awareness and hence its ability to navigate future regulatory changes. On the other hand, investors may view greater climate disclosure as a negative signal about the firm's climate risk exposure and hence heightened regulatory costs in the future. Thus, how the qualitative information conveyed in climate disclosure affects investor expectations is ultimately an empirical question.

To shed light on this question, we examine the effect of ex ante climate disclosure on the stock market reaction to the adoption of the Paris Agreement using a sample of 3,434 U.S. public companies with conference call transcripts in 2015. The Paris Agreement represents a particularly attractive setting for our analysis because it is the first major international agreement on climate change that the U.S. participated in, and the content and outcome of the Agreement came largely as a surprise.[4] To capture climate-related disclosure, we follow recent research that employs a novel approach to identify conversations in quarterly earnings conference calls about climate

[4] Prior to the meeting, observers raised questions about the likelihood of the United Nations Framework Convention on Climate Change (UNFCCC) members reaching an agreement (Booker, 2015), given substantial disagreement among world leaders at the 2009 Copenhagen Summit with respect to proposed limits on emissions (Monasterolo and de Angelis, 2020; Cao et al., 2021; Seltzer et al., 2021). For instance, Christiana Figueres, Former Executive Director of UNFCCC, noted in her 2016 TED presentation that "no one believed that a global agreement could ever be possible" (https://www.youtube.com/watch?v=MIA_1xQc7x8).

change exposure (Sautner et al., 2021). In particular, we use the count of a broad set of climate change bigrams (word pairs) to capture disclosure about general climate change exposure (*CC_EXPOSURE*), as well as the count of bigrams related to three specific climate-related topics: technological opportunities (*CC_OPP*), regulatory interventions (*CC_REG*), and physical threats (*CC_PHY*).[5] We take the average of each measure over the four quarters prior to the Paris Agreement to capture pre-meeting voluntary climate disclosure.

Before testing our main analysis, we first document the market reaction around the Paris Agreement. Consistent with prior research (Diaz-Rainey, Gehricke, Roberts, and Zhang, 2021), we find significantly negative 3-day abnormal returns around the signing of the Paris Agreement, which suggests that the Agreement has on average a negative effect on firm value, likely due to higher expected regulatory costs. We further find that the negative reaction is stronger for firms with high carbon emission intensity (hereafter, carbon-intense firms),[6] consistent with these firms facing greater potential for stranded assets, increases in the cost of doing business, and financial constraints due to climate-related capital requirements (e.g., Delis et al., 2019; Seltzer et al., 2021), and hence greater potential for higher regulatory costs triggered the Paris Agreement. In addition, climate change exposure may be more quantifiable for carbon-intense firms that have direct carbon emissions (i.e., Scope 1 emissions). Thus, investors may find climate disclosures particularly useful in assessing the impact of policy shocks on firm value for carbon-intense firms. As such, we test our main hypothesis separately for carbon-intense firms.

[5] These measures were developed by Sautner et al. (2021) using a comprehensive list of climate change exposure bigrams captured from conference calls by a machine learning algorithm. See Section 3.3 for more details.
[6] We define carbon-intense firms as firms in the top 10 industries by average Scope 1 carbon intensity in Ilhan et al. (2021). Our results are robust to alternative definitions of carbon-intense firms. See Section 5.3.1 for a detailed discussion.

Turning to our main hypothesis on the effect of climate disclosure, we find that climate disclosure does not have a significant effect on the market reaction around the Agreement for the full sample. We find a strong disclosure effect, however, for the carbon-intense subsample—carbon-intense firms with greater climate disclosure prior to the meeting are associated with higher abnormal returns around the announcement. This result is economically significant—a one-standard-deviation increase in climate disclosure (*CC_EXPOSURE*) is associated with a 2.0% increase in 3-day abnormal returns. These findings suggest that ex-ante climate disclosure can convey information that helps investors assess the implications of regulatory shocks for future cash flows. In particular, such disclosures serve as a positive signal to investors about a firm's climate awareness, which is rewarded by the stock market and helps alleviate the negative impact of policy shocks to firm value.

We next examine which types of climate disclosure are particularly informative for investors. Specifically, we examine climate discussions related to technological opportunities, regulatory interventions, and physical threats. We find that the documented positive association between the broad climate change measure and 3-day abnormal returns around the Agreement for carbon-intense firms is driven primarily by discussions of climate-related opportunities (e.g., investment in renewable energy), which suggests that the content of climate disclosure matters. Several additional observations are worth noting. First, climate discussions on all three topics are more prevalent among carbon-intense firms compared with firms in other industries, which is not surprising given their exposure to climate change is higher. Second, when carbon-intense firms discuss their climate exposure, they are also more likely to speak about the opportunities that come with such exposure. Third, we observe a positive disclosure effect even when the discussion of climate-related opportunities is accompanied with risk statements or negative tones. Overall, these

findings suggest that for carbon-intense firms, such voluntary disclosure is not merely green washing and that discussions of climate-related opportunities are not viewed as cheap talk by investors.

Having established a positive disclosure effect for carbon-intense firms, we investigate the moderating effect of regulatory stringency. Climate disclosure should matter more for firms that face more stringent environmental regulations, as climate-related costs are likely higher for these firms (Seltzer et al., 2021). Given substantial variation in the degree of environmental regulatory enforcement at the state level (Konisky, 2007), we use state-level enforcement data from the Environmental Protection Agency (EPA) to capture the stringency of enforcement. Consistent with our conjecture, we find that the disclosure effect is significantly stronger for firms in states with more stringent environmental enforcement, suggesting that climate disclosure is particularly useful to investors of firms that face greater regulatory scrutiny.

In additional analysis, we further examine whether ex ante climate disclosures affect investor uncertainty around the Paris Agreement. Similar to the findings for returns, we find a significant disclosure effect only for the carbon-intense subsample. In particular, we document a negative association between climate-related disclosure and changes in implied volatility around the Agreement for the carbon-intense subsample. This result holds after controlling for the level of implied volatility prior to the Agreement, for firm-level characteristics such as firm size, leverage, book-to-market, capital intensity, profitability, and analyst following, as well as for industry fixed effects. We further find that the negative association between climate disclosure and investor uncertainty around the Agreement that we document for carbon-intense firms is driven primarily by discussions of climate-related opportunities. These findings suggest that climate

disclosures, especially opportunities-related disclosures, not only help investors assess the impact of regulatory shocks on future firm value, but also help resolve investor uncertainty.

Our results are subject to an endogeneity concern. Specifically, while the content and outcome of the Paris Agreement were largely a surprise, the timing of the event was known and hence it is possible that firms increased disclosure in anticipation of heightened regulation triggered by the Agreement leading to lower firm value. We address this concern in two ways. First, given that carbon emissions concentrate in certain industries, we include industry fixed effects to control for the impact of industry-level regulatory uncertainty as well as unobservable variation across industries. Second, we perform sensitivity tests in which we exclude *i*) conference calls from the two quarters immediately before the Agreement and *ii*) firms that increased their climate disclosure in the two quarters immediately before the Agreement. We find qualitatively similar results in both tests, which suggests that our main results are unlikely to be driven by firms' strategic disclosure.

This paper contributes to several strands of literature. First, our study contributes to the nascent literature on climate risk and asset prices. Recent studies find that investors incorporate climate risk into asset prices and investment decisions (Ilhan et al., 2021; Bolton and Kacperczyk, 2021; Nagar and Schoenfeld, 2022; Li et al., 2021; Cao et al., 2021). Our study complements this research by showing that ex ante voluntary qualitative disclosure can affect investors' assessment of firm value. Our findings also have practical implications for managers' climate disclosure decisions. As firms adjust their operating and investing strategies to evolving climate regulations, one should not ignore the importance of their climate reporting strategy. In particular, our findings highlight the potential benefits of transparent and credible climate reporting for firm value, especially for firms with high carbon intensity and firms that face greater regulatory scrutiny.

Second, our study contributes to the growing literature on ESG disclosure, and more specifically, climate disclosure. One stream of this research examines the determinants of voluntary disclosure and its effect on shareholder value by using CSR news and the Carbon Disclosure Project (CDP) (e.g., Stanny and Ely, 2008; Matsumura et al., 2014; Lee et al., 2015). While recent research explores different forms of climate disclosure in conference calls and annual reports, the main focus has been to derive firm-level measures of climate change exposure (e.g., Li et al., 2021; Nagar and Schoenfeld, 2022; Sautner et al., 2021).[7] Our study complements this literature by shedding light on how ex ante climate disclosure can help investors assess the impact of future policy shocks.

Lastly, our findings have implications for the SEC's proposed rules requiring climate disclosure.[8] We show that not all climate disclosures are helpful to investors, which suggests that the content of disclosure matters. In addition, we find that climate disclosure is most beneficial to investors of carbon-intense firms, which suggests that climate disclosure is not one-size-fits-all. Although debate continues as to whether the SEC has the authority to mandate climate disclosures and whether the proposed disclosure rules can achieve their intended objective of protecting investors, our findings suggest that if they are approved, greater effort should be made in identifying areas of disclosure for carbon-intense firms, which are the key contributors to GHG emissions. Overall, prioritizing efforts to enhance the reliability and transparency of climate

[7] See Christensen, Hail, and Leuz (2021) for a comprehensive review of the literature on the effects of voluntary and mandated CSR reporting.

[8] While the SEC has been pushing to mandate climate-related disclosures, the issue is subject to debate among investors, regulators, and academics alike. For example, SEC Commissioner Hester Peirce is against the proposal on grounds that "we are not the Securities and Environment Commission" (https://www.sec.gov/news/statement/peirce-climate-disclosure-20220321). There is also a divergence of opinion among researchers as to whether the SEC has the authority to impose mandatory climate-related disclosure rules (Vollmer, 2021; Georgiev, 2022; Cunningham et al., 2022). We note that our findings do not speak directly to whether climate disclosure should be required. Rather, our goal is to provide evidence on the effect of ex ante voluntary climate disclosure on firm value and to shed light on when disclosure is more useful to investors. In that vein, our findings can potentially inform the current debate on the costs versus benefits of mandatory disclosure.

disclosure associated with direct carbon emissions (Scope 1 emissions) represents a potentially fruitful avenue for regulators in their ongoing fight against global warming.[9]

The rest of the paper is organized as follows. Section 2 reviews related literature and develops our hypotheses. Section 3 describes our sample, variables, and research design. Sections 4 and 5 present our main empirical results and results of additional analyses, respectively. Finally, Section 6 concludes.

2. Literature Review and Hypotheses

2.1. Climate Reporting Regulations

The introduction of the Greenhouse Gas Reporting Program (GHGRP) was a notable milestone for climate reporting in the US as it was the first nationwide database of GHG emissions. This program was developed by the Environmental Protection Agency (EPA) under the Clean Air Act and, after issuing a proposed rule in 2009, the EPA solicited comments from the industry, trade associations, local governments and environmental groups and held a series of public hearings. The final rule, announced in September 2009, requires disclosure of GHG emissions at the facility level, as opposed to the voluntarily disclosed data available previously (e.g., under non-compulsory programs such as Climate Registry or Climate Leaders) at the company level (Greenhouse Gas Protocol, 2009).[10] The Program thus provides the first detailed, externally verified, and comparable information on firms' carbon emissions in the U.S.[11]

[9] There is an ongoing debate on the value of direct (Scope 1) versus indirect (Scope 2 and Scope 3) GHG emission disclosure (e.g., Kaplan and Ramanna, 2021). See the GHG Inventory Guidance from the EPA for a more detailed description of Scope 1 to Scope 3 disclosure. Source: http://www.epa.gov/climateleadership/

[10] The rule requires any facility in the US with direct GHG emissions above 25,000 metric tons of CO2-equivalent a year to report GHG emission data. The EPA estimates that around 85-90% of all GHG emissions in the U.S. are covered by the GHGRP (CRS, 2021).

[11] A recent stream of literature exploits the introduction of the GHGRP and other similar legislative changes to study the real and financial effects of mandatory carbon disclosure (e.g., Downar et al, 2021; Tomar, 2022; Zotova, 2022).

The Securities and Exchange Commission (SEC) has also adopted various initiatives on climate disclosures in the past decade. In 2010, the SEC issued interpretive guidance to clarify the disclosure requirements set out in Regulation S-K, which may require public companies to disclose information about their climate-related risks—especially in topics such as business description, risk factors, and management's discussion of financial matters—to help contextualize their exposure to the legislative, regulatory, and business impacts of climate change (SEC, 2010). This continued to be on the Commission's agenda, as reflected in the 2019 proposal to modernize Regulation S-K to include environmental, social, and governance (ESG) disclosures (SEC, 2020); however, no specific climate-related disclosures were mandated.

In early 2021, the SEC issued a Statement of Review requesting their staff to examine climate-related disclosures in public company filings and, following this, opened a public consultation on climate-related disclosures in March 2021 to assist the SEC's staff in their evaluation (SEC, 2021a).[12] This initiative sparked significant public interest, with the SEC receiving more than 550 comment letters from different organizations. Commission Chair Gary Gensler noted that three out of every four comment letters supported mandatory disclosures (SEC, 2021b).[13]

Subsequently, the SEC revealed that a proposed rule on climate-related disclosures for public corporate filings was in progress, which was eventually released in March 2022 with a comment period extending until mid-June 2022 (SEC, 2022). At more than 500 pages in length,

[12] The tenor of this public consultation was to obtain input on SEC's rules and guidance as applied to climate change disclosure. Among others, it sought comments on whether and how existing disclosure requirements in Regulation S-K should be modified, as well as potential new requirements that might be adopted in the future. Additionally, acting Chair Allison Herren Lee created a Climate and ESG Task Force in the Division of Enforcement to focus on the perceived under-reporting of climate risks under the SEC's existing rules.

[13] The comments were concentrated in the following requirements: *i)* climate-related disclosures when they are material to the operation, *ii)* the quantification of Scope 1 emissions and certain indirect emissions, and *iii)* consistency with current frameworks such as the Sustainability Accounting Standards Board (SASB), the Climate Disclosure Standards Board, and the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

the proposal includes several aspects of climate-related disclosure which are intended to protect investors and inform them about the climate-related risks companies face by producing consistent, comparable, and reliable climate-related disclosures in their registration statements and annual reports (SEC 2022). The proposed disclosure includes, but is not limited to, the disclosure of direct (Scope 1) and indirect (Scope2) carbon emissions,[14] climate-related financial impacts, transitions risks associated with the mitigation of, or adaptation to, climate-related risks, and some financial metrics to be included in a note to the audited financial statements.

There is growing disagreement, however, on whether the SEC's climate-related disclosure rule will deliver on the stated objective of protecting investors. Although advocates argue that the proposed rules are firmly grounded within the SEC's mandate and can help investors gauge the effects of climate change on firm valuation (Georgiev 2022), critics—including dissenting voices from within the SEC[15]—argue that *i)* the proposed rules are a political response to demands from vocal and self-interested groups, instead of a wider action to protect investors at large, *ii)* the subject of the rule is within the statutory power of the EPA, not the SEC, and *iii)* no clear cost-benefit analysis supports the proposed rule, with a potentially large monetary burden and highly speculative benefits (Cunningham 2022). Further, the proposed rule does not seem to solve the current debate on how to report upstream and downstream emissions from supply chain partners, which may represent a great portion of total emissions (Kaplan and Ramanna, 2021). It is also unlikely to provide substantial new emissions data as the GHGRP already accounts for the disclosure of 85-90% of annual US emissions (CRS 2021; Cunningham, 2022).

[14] Scope 3 emissions would only be disclosed if they are material for the company or if the company has an emissions reduction target in place that includes Scope 3 emissions.

[15] Commissioner Hester M. Peirce issued a lengthy dissenting statement on the proposed rule, indicating that it "will not bring consistency, comparability, and reliability to company climate disclosures" and that it "turns the disclosure regime on its head" (https://www.sec.gov/news/statement/peirce-climate-disclosure-20220321).

2.2. The Paris Agreement

The Paris Agreement, a legally binding international accord on climate change (UNFCCC), is widely regarded as the most important milestone toward international alignment to curb the impact of global warming by enabling a coordinated effort to develop and implement adaptation and mitigation actions (Monasterolo and De Angelis 2020; Ilhan et al., 2021; Seltzer et al., 2021; Cao et al., 2021). It was adopted in 2015 by 196 parties and set an initial path toward decarbonizing the economy by providing a framework for nations to both make and report progress toward limiting the increase in global warming to 2 (and preferably 1.5) degrees Celsius with respect to pre-industrial levels (UNCCC, 2015). It stipulated a system for countries to pledge and review Nationally Determined Contributions (NDCs) to reduce emissions and gradually encourage stricter targets.[16] This shifted the landscape of the climate change policy negotiations and paved the way for the largely unexpected and widespread success of the deal (Kruse et al., 2020; Falkner 2016).

Although negotiations started weeks ahead of the meeting, the probability that an agreement would be reached was far from certain.[17] Prior to the meeting, observers raised serious doubts about the likelihood that the UNFCCC members would reach an agreement and the media even went so far as to call it the potential "flop of the year" (Booker, 2015) given the previous failure in the Copenhagen Summit in 2009 which led to substantial disagreement among world leaders with respect to emissions limits (Monasterolo and de Angelis, 2020; Cao et al., 2021; Seltzer et al., 2021). Indeed, negotiations over the global warming threshold (i.e., 1.5 or 2.0 degrees

[16] NDCs are considered the heart of the Paris Agreement. They embody the plans to mitigate GHG emissions and to take adaptative measures to deal with the impact of climate change by setting targets and systems to verify progress and keep on track. These pledges are updated every five years and are the responsibility of each country. Usually, they require one or more local ministries to lead their development an include all relevant aspects, as the commitments have to be balanced with other national priorities.

[17] For instance, Christiana Figueres, Former Executive Director of the UNFCCC, revealed in her 2016 TED presentation that among the team leading the negotiations "no one believed that a global agreement could ever be possible" (https://www.youtube.com/watch?v=MIA_1xQc7x8).

Celsius) and the position of big oil producers, among other issues, posed a significant threat to its success up to the very last minute. This led to extended negotiations far beyond trading hours that forced the parties to reschedule the adoption of the agreement from Friday, December 11 to Saturday, December 12, with intense negotiations continuing overnight (Kruse et al. 2020).

Taken together, there are at least three institutional characteristics that make the Paris Agreement an attractive setting to study the market response to an increase in climate-related regulatory risk. First, it is broadly considered as a landmark event leading to increased climate change awareness. Second, it came largely as a surprise (Kruse, et al., 2020; Monasterolo and De Angelis, 2020; Ilhan et al., 2021; Seltzer et al., 2021; Cao et al., 2021). Third, it attracted significant media attention, and hence it is unlikely that it went unnoticed by investors (Engle et al., 2020; Kruse et al., 2020). Given these features, prior research has exploited this setting to investigate the market reactions to climate change news (Ginglinger and Moreau, 2019; Delis, de Greiff, and Ongena, 2019; Seltzer, Starks, and Zhu, 2021; Engle et al., 2020; Krueger, Sautner, and Starks, 2020; Monasterolo and De Angelis, 2020; Cao et al., 2021; Diaz-Rainey et al., 2021). In this study, we extend this literature by examining the effect of pre-agreement climate-related disclosures on investors' expectations of firm value around this event.

2.3. Climate Disclosures and Firm Value

The notion that managers will disclose information that is favorable for the firm and withhold unfavorable news is a long-held view from voluntary disclosure theory (Dye 2001; Verrecchia 2001). Investors can rationally assume that companies with greater climate disclosure are more prepared to navigate future regulatory developments and thus are able to shield investor wealth upon regulatory shocks such as the Paris Agreement. On the flipside, companies that are

less vocal about climate exposures may be viewed as inadequately prepared to face more stringent regulatory environments, and therefore suffer greater loss in market value.

This view has been probed by prior literature with mixed and inconclusive results. On the one hand, previous research documents that market reactions to disclosers and non-disclosers for the Carbon Disclosure Project (CDP) are not significantly different. Kim and Lyon (2011) find that participation in CDP survey does not affect share prices for global 500 companies.[18] While Griffin et al. (2017) document a negative market reaction to carbon emissions news, they do not find a significant difference in valuation coefficients between disclosers and non-disclosers to the CDP, inconsistent with -Matsumura et al. (2014) that suggest a further market penalty for non-disclosure of GHG emissions. Recently, Kim (2022) finds that only mutual funds strongly committed to green investments react to firms' net-zero pledges, while the overall reaction is insignificant.

On the other hand, prior studies provide limited evidence on the role of voluntary environmental disclosure in assessing firm value. These studies tend to focus on a single industry (e.g., chemical or oil and gas) and have a limited sample size. Blacconiere and Patten (1994) study a sample of 47 firms in the chemical industry and document that ex ante voluntary disclosures in firms' 10-Ks can protect companies from negative market reactions to environmental disasters, namely, a chemical leak. However, the significance of this finding is muted when firm size (logarithm of revenue) is included in their model. Similarly, Blacconiere and Northcut (1997) report less negative market reactions for firms with more extensive environmental disclosures upon the announcement of legislative actions expected to increase environmental compliance costs in the chemical industry. However, the results are not robust to alternative measures of disclosure

[18] They document an increase in value only for the subset of CDP disclosers in GHG-intensive industries in countries that had not ratified the Kyoto Protocol around the Russia's ratification of the Kyoto Protocol.

that are more closely related to environmental efforts. Heflin and Wallace (2017) find less negative wealth effects for oil and gas companies with more environmental disclosures prior to the BP Oil spill of 2010. Yet again, the results are circumscribed to a limited sample of companies in a single industry, and therefore, it is not clear whether they can be generalized beyond these boundaries.

Therefore, whether and how ex ante climate-related disclosures affect how investors react to climate-related regulatory shocks remains an open empirical question, which is the subject of our inquiry.

2.4. Hypothesis Development

In this paper, we investigate whether firms' voluntary climate disclosure affects investors' expectations of firm value around climate-related regulatory shocks. The Paris Agreement is arguably the most important climate-related political event to date and the first legally binding international accord on climate change (Monasterolo and De Angelis, 2020; Ginglinger and Moreau, 2019; Cao et al., 2021). To achieve the long-term goal of curbing global warming, it requires countries to submit their plans for climate action to reduce greenhouse gas emissions, which implies the development of stronger environmental regulations in each signatory country. Extant research documents negative market reactions to the Paris Agreement, especially for companies in industries with high levels of GHG emissions(Diaz-Rainey et al., 2021; Mukanjari and Sterner, 2018; Monasterolo and De Angelis, 2020; Kruse et al., 2020), as these companies face a greater potential for stranded assets, significant increases in the cost of doing business, and financial constraints due to climate-related capital requirements (Delis et al., 2019; Van der Ploeg and Rezai, 2020; Rozenberg et al., 2020; Ilhan et al., 2021; Seltzer et al., 2021; Gingingler and Moreau, 2021).[19]

[19] Pastor and Veronesi (2012, 2013) argue that governments decide on their policies based on the expected impact on firms' profitability and the political costs that they entail. Given investors' inability to fully predict such policies, they

Greater disclosure about climate change exposure should help investors to better contextualize the effect of policy shocks on firm value. However, it is unclear ex ante whether the market perceives such information as a positive or negative signal. On the one hand, investors may consider firms with more transparent discussions of climate exposure as having greater climate awareness and thus more prepared to navigate future regulatory changes.[20] On the other hand, investors may view greater climate disclosure as a signal of higher climate risk exposure, and hence expect firms to incur higher regulatory costs in the future. In addition, unlike other types of firm-specific disclosure, climate disclosure is related to events that are inherently less predictable. Many firms struggle to obtain a clear assessment of their exposure to climate risk as well as the potential impact of climate-related events, which reduces their ability to provide reliable information on such exposure and potential impact to external stakeholders (Barnett et al., 2020). Moreover, firms may have incentives to engage in greenwashing by communicating overly positive environmental performance (Kim and Lyon, 2011; de Freitas Netto et al., 2020; Hail et al., 2021; Grewal, 2022). Prior research suggests that companies use strategic changes in the rhetoric of communication to obfuscate actual performance by adopting grammatical structures that convey better performance (Crilly et al., 2016), adding complexity to disclosures (Fabrizio and Kim, 2019), and using tone to shift the narrative (Hail et al., 2022). Hence, whether the information from climate disclosure is sufficiently reliable or credible to affect investor expectations is ultimately an empirical question. Accordingly, we state our first hypothesis (in alternative form) as follows:

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must rely on political events to learn about the political costs and the likelihood of introducing them. Abstracting from this theory, we argue that climate-related policy events such as the Paris Agreement act as information shocks that update investors' beliefs and expectations regarding future regulatory costs associated with climate change policies, and hence affect their assessment of firm value.

[20] Recent research by Bochkay et al., (2022) document that adopters of voluntary sustainability disclosure standards improve their environmental performance and lower their emissions following the adoption.

***H1**: Firms in industries with higher direct carbon emissions experience a lower reduction in firm value around the Paris Agreement when they have more ex-ante voluntary disclosure of climate risk exposure.*

Another important question in the area of climate disclosure is what type of information helps investors assess firm value in the wake of regulatory shocks. Prior research finds that investors reward companies that exploit more opportunities in the new low-carbon economy (Monasterolo and De Angelis 2020; Kruse et al., 2020). Therefore, we conjecture that disclosure signaling a firm's ability and preparedness to take advantage of technological opportunities in the new low-carbon economy would provide investors with more reassurance regarding firm value. We formally state this in the second hypothesis:

***H2**: The effect of climate disclosure on firm value for firms with higher direct carbon emissions is driven by the disclosure of opportunities related to climate change.*

Finally, we examine whether the level of regulatory enforcement can impact the effect of climate disclosures on firm value. Prior studies document substantial variation in environmental regulatory stringency across different states (Konisky, 2007). Seltzer et al. (2021) find that climate-related costs are likely higher for firms operating in states with more environmentally-related enforcement actions. Therefore, we conjecture that the impact of climate disclosures on investors' expectation of firm value would be stronger for companies headquartered in states with more stringent environmental enforcement, as they may bear higher costs from increased climate-related regulations and disclosure may play a more important role for them. Thus, our last hypothesis is stated as follows:

***H3**: The effect of climate disclosures on firm value for firms with higher direct carbon emissions is stronger for firms that face more stringent environmental regulations.*

3. Sample, Variables, and Research Design

3.1. Sample

Our sample includes public companies listed in the U.S. with earnings conference calls over the four quarters in 2015. We collect stock returns data from CRSP. We gather firm-level disclosure measures for climate-related discussion in conference calls from Sautner et al. (2021).[21] They use a machine learning algorithm to identify bigrams (i.e., pairs of words) associated with climate change topics and count the frequency of these bigrams in conference call transcripts. We use their measures of climate change disclosure in general as well as discussion specific to three types of climate-related topics (i.e., technological opportunities, regulatory interventions, and physical threats). We follow Seltzer et al. (2021) to collect and compile state environmental regulation data from the EPA's Enforcement and Compliance History Online website. Finally, we gather firm-level financial information from Compustat and analyst following from I/B/E/S. After merging the disclosure data with returns and other firm level characteristics, we arrive at a final sample of 3,434 firm-level observations.

3.2. Measure of Abnormal Returns: Fama-French Three-Factor Returns

We use the Fama-French three-factor model (Fama and French, 1993) as our expected returns model[22] and calculate the abnormal returns for stock *i* on day *t* according to the following equation:

$$AR_{i,t} = R_{i,t} - [R_{f,t} + \widehat{\alpha_i} + \widehat{\beta_{1,i}}(R_{m,t} - R_{f,t}) + \widehat{\beta_{2,i}}SMB_t + \widehat{\beta_{3,i}}HML_t]$$

where $R_{f,t}$ is the risk-free rate on day *t*, $(R_{m,t} - R_{f,t})$ is the excess market return on day *t*, SMB_t (Small minus Big) is the second Fama-French factor, and HML_t (High minus Low) is the third

[21] Their data has been made available on the following website: https://osf.io/fd6jq/

[22] Our results are robust to using the CAPM or Fama-French five-factor model as the expected returns model (untabulated).

Fama-French factor.[23] For each stock i, we use a 200-day estimation window from t=-250 to t=-51 to estimate the factor loadings $\widehat{\beta_{1,i}}$, $\widehat{\beta_{2,i}}$, $\widehat{\beta_{3,i}}$, as well as $\widehat{\alpha_i}$. The three-day cumulative abnormal returns for firm i around the Paris Agreement is then calculated as[24]

$$CAR(-1,1)_i = \sum_{t=-1}^{t=1} AR_i$$

3.3. Voluntary Disclosure of Climate Change Exposure

We measure voluntary climate-related disclosure building on extant research that examines conference calls as a rich source of information. Conference calls are a significant market event where management presents their views and answers analysts' questions about a firm's performance and risk exposures. We employ measures developed by Sautner et al. (2021), who adapt a machine learning algorithm devised by King et al. (2017) to identify climate-related discussion in conference calls. The algorithm requires a relatively limited number of initial bigrams unambiguously related to climate change and then searches for new climate-related bigrams in a large sample of earnings call transcripts between 2002 and 2019. Climate disclosure measures are calculated as the frequency of climate-related bigrams that appear in a firm's conference call.[25]

We use several measures constructed by Sautner et al. (2021) at the conference call-level. The first measure (*CC_EXPOSURE*) represents general discussion of climate-related topics prior

[23] We obtain daily Fama-French 3 factors from Kennedy French's website: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[24] Since the Paris Agreement was adopted on a non-trading day (December 12, 2015), we use the next trading day as the event date (December 14, 2015).

[25] Focusing on bigrams instead of unigrams allows for a much more comprehensive and less noisy identification of climate change discussion as it can greatly reduce false positives. For instance, unigrams such as *climate* could be highly ambiguous, as they might refer to environmental concerns such as in *climate change*, but also to unrelated topics, such as when used in *economic climate*. This can be avoided using bigrams and thus, counting bigrams represents an improvement over word counts and a cleaner identification of environmental discussion (Sautner et al., 2021; Hassan et al., 2019, 2020; Li et al., 2021).

to the adoption of the Paris Agreement, computed as the number of bigrams associated with climate change divided by the total number of bigrams in the conference call transcript. We also use three disclosure measures that capture specific topics related to technological opportunities(*CC_OPP)*, regulatory interventions (*CC_REG*), and physical threats (*CC_PHY*) related to climate change, respectively. Additionally, we obtain a measure of the discussion of climate risks computed as the proportion of climate-related bigrams appearing in the same sentence as the words *risk* or *uncertainty* (or any of heir their synonyms) in the transcript (e.g., *CC_OPP_RISK*). Finally, we use variables that capture the sentiment associated with the climate change topics by measuring the frequency with which bigrams are accompanied by positive and negative tone words from Loughran and McDonald (2011) (e..g., *CC_OPP_POS*, *CC_OPP_NEG*). Appendix C presents some examples of these measures in conference calls held during the year 2015. We access these climate change discussion scores at the firm-quarter-level from the authors' website, multiply them by 100, and average them over the four calendar quarters of 2015 to arrive at our independent variables of interest. See Appendix A for more details on these variables.

3.4. Research Design

3.4.1. Timeline

The timeline of our research design is summarized in Figure 1. We compute the three-day cumulative abnormal returns around the signing of Paris Agreement on December 12, 2015 (i.e., *CAR(-1,+1)*). The average firm-level climate-related disclosure scores (i.e., *CC_DISCLOSURE*) are computed from conference calls during the four calendar quarters of the same year. Firm-level controls are computed as of the nearest fiscal year-end prior to the adoption of the Paris Agreement.

3.4.2. Market Reaction around the Paris Agreement

To test the association between voluntary climate disclosures and the market reaction around the Paris Agreement, we estimate the following specification:

$$CAR(-1,+1)_i = \beta_0 + \beta_1 CC\_DISCLOSURE_i + \beta_3 X_i + \delta_k + \varepsilon_i, \quad (1)$$

where the main independent variable of interest, *CC_DISCLOSURE*, is either the average level of disclosure related to climate topics in general (i.e., *CC_EXPOSURE*), or the average level of climate disclosures related to specific topics (*CC_OPP*, *CC_REG*, or *CC_PHY*). The dependent variable, $CAR(-1,+1)$, is the three-day cumulative abnormal returns around the Paris Agreement. Therefore, if firms' voluntary climate disclosure in conference calls prior to the Paris Agreement serves as a positive signal for investors' expectations of firm value, we would expect β_1 to be positive and significant.

We control for firm-level characteristics (i.e., X_i) documented in prior literature known to influence the firm's information environment (Li et al., 1997; Matsumura and Prakash, 2014; Stanny and Ely, 2008; Stanny, 2013). These include firm size (*SIZE*), book-to-market ratio (*BTM*), capital intensity (*CAPINT*), profitability (*ROA*), and analyst following (*FOLLOW*), and leverage (*LEV*). We winsorize all climate disclosure measures and control variables at the top and bottom one percent and include industry fixed effects (δ_k) at the two-digit SIC level to control for unobserved industry characteristics. Standard errors are clustered at the two-digit SIC level to account for unspecified correlations within an industry. Variable definitions are detailed in Appendix A.

4. Empirical Analyses

4.1. Descriptive Statistics

We first document the trend in stock returns around the Paris Agreement. Figure 2 Panel A presents the cumulative abnormal returns (CARs) over the 45 trading days before and after the Paris Agreement for our *High CO_2* group and *Other* group. [26] We observe consistently negative CARs starting 45 trading days prior to the Paris Agreement for the *High CO_2* subsample, indicating that the market may have anticipated to a certain extent the negative value impacts for carbon-intensive firms even before the Paris Agreement was passed. In addition, the average CARs around the event date (i.e., t=0) appear to be more negative for the *High CO_2* subsample than the *Other* subsample, suggesting that the Paris Agreement mainly serves as a negative shock to the value of carbon-intensive firms.[27]

Figure 2 Panel B plots separately the CARs over the same 90-day window for firms in the *High CO_2* subsample with high and low climate disclosure (i.e., above and below the median value of *CC_EXPOSURE*). We observe that firms with higher climate disclosure experience less negative CARs around the Paris Agreement as well as an increasing trend in CARs afterwards, while firms with lower climate disclosure show more negative returns after the Paris Agreement. Figure 2 Panel C shows that such patterns do not exist for the *Other* subsample. In general, the plots are consistent with prior studies that find a negative market reaction around the Paris Agreement for carbon-intensive firms (Diaz-Rainey et al., 2021; Mukanjari and Sterner, 2018; Monasterolo and De Angelis, 2020; Kruse et al., 2020), and support our hypothesis that voluntary climate-related disclosure can help mitigate the negative impacts on firm value.

[26] We define carbon-intense firms as firms in the top ten industries by average Scope 1 carbon intensities in Ilhan et al. (2021). See Table 2 for the complete list of industries in this category.
[27] Table 2 Panel A shows that the average three-day CARs around the Paris Agreement for the *High CO_2* group is -2.9%, significantly lower than the *Other* group (-0.6%).

Table 1 Panel A displays descriptive statistics for the variables used in our analyses. *CC_EXPOSURE*, which measures general discussion of climate-related topics, has a mean (median) of 0.089 (0.026). We also present the descriptive statistics for the three measures of climate disclosure on specific topics, *CC_OPP*, *CC_REG*, and *CC_PHY*, which have a mean (median) of 0.035 (0.007), 0.004 (0.000), and 0.001 (0.000), respectively. The standard deviations of *CC_EXPOSURE, CC_OPP, CC_REG,* and *CC_PHY* are 0.213, 0.100, 0.014, and 0.004, respectively, suggesting that there is more cross-firm variation in *CC_EXPOSURE* and *CC_OPP*. The average three-day CARs around the Paris Agreement is -0.9% in our full sample, suggesting that the agreement is expected to reduce firm value on average.

Regarding control variables, the companies in our sample are relatively large firms – their mean (median) total assets (*SIZE*) is $1,720 ($1,719) million, and they are followed by a mean (median) of 7.65 (8.00) sell-side equity analysts (*FOLLOW*). Panel B presents the Pearson (Spearman) correlations below (above) the diagonal. The three-day CARs have a positive and significant correlation with *CC_OPP*, *CC_OPP_RISK*, *CC_OPP_POS*, and *CC_OPP_NEG*. This suggests the potential role of disclosure about climate-related opportunities in alleviating investor concerns. It is also interesting to note the positive correlations between the level of capital intensity and disclosure, suggesting that companies with a higher likelihood of having stranded assets tend to discuss more about climate risks.

Table 2 Panel A presents descriptive statistics for the main variables used in our analyses separately for firms in industries with high carbon emission intensity (*High* CO_2 subsample) and firms in other industries *(Other* subsample). Our *High* CO_2 subsample is composed of 454 firms from carbon-intense industries. They experience significantly more negative CARs around the Paris Agreement (mean = -2.9%) compared with firms in other industries (mean = -0.6%). They

also discuss climate issues significantly more than the firms from other industries, as reflected in a higher mean for all climate disclosure measures. Panel B presents the climate disclosure scores by industry in our sample, sorted from highest to lowest by *CC_EXPOSURE*.

4.2. Main Empirical Results

4.2.1. Climate Disclosure and Market Reaction around the Paris Agreement

Table 3 reports the results from estimating Model (1) with *CC_EXPOSURE* as the main independent variable, which captures the general discussion on climate change exposure. Columns (1) – (2) report the results for the full sample. While the coefficients of *CC_EXPOSURE* are positive, they are not significant. Next, we estimate Model (1) separately for firms in the *High* CO_2 subsample (Columns (3) and(4)) and *Other* subsample (Columns (5) and (6)). In Columns (1), (3) and (5), we report the univariate regression results including only *CC_EXPOSURE* as the explanatory variable. In Columns (2), (4) and (6), we add the full set of firm-level control variables defined in Section 3.4.2. We document a positive association between *CC_EXPOSURE* and three-day CARs around the adoption of the Paris Agreement only in the *High* CO_2 subsample. This result is also economically significant. For instance, in our primary specification in column (4), the coefficient of *CC_EXPOSURE* indicates that a one standard deviation increase in *CC_EXPOSURE* is associated with a 2.0% (= 0.369*0.054) increase in three-day CARs for an average firm in the *High* CO_2 subsample. The results suggest that climate discussions in conference calls prior to the Agreement help investors better contextualize the implication of regulatory shocks on carbon-intensive firms' future cash flows, which alleviates negative shocks to firm value.

4.2.2. Climate Disclosure and Market Reaction around the Paris Agreement: Topics of Disclosure

Table 4 reports the results from estimating Equation (1) using measures of climate disclosure related to three specific topics (*CC_OPP*, *CC_REG*, and *CC_PHY*) for firms in the *High*

CO_2 subsample (Columns (1) to (3)) and the *Other* subsample (columns (4) to (6)). We find a strong significant positive association between *CC_OPP* and three-day CARs (coefficient = 0.096, t = 21.531) and a marginally significant association between *CC_REG* and three-day CARs (coefficient = 0.324, t = 1.968) for the *High CO_2* subsample. This supports our hypothesis that climate disclosure on technological opportunities is particularly useful in mitigating negative shocks to firm value for carbon-intensive firms, as they may use this venue to display better preparedness for the regulatory challenges following the Paris Agreement. On the contrary, none of the coefficient estimates of *CC_OPP, CC_REG, and CC_PHY* is statistically significant for the *Other* subsample. Overall, these results indicate that climate disclosure has a stronger impact on carbon-intense firms, especially when the discussion centers on firms' opportunities related to climate change.

4.2.3. Climate-Related Opportunities Disclosure and Market Reaction around the Paris Agreement: Risk and Sentiments

The results we document so far suggest that voluntary disclosure on technological opportunities related to climate change helps carbon-intensive firms mitigate negative stock market reaction around the Paris Agreement. We further explore whether such effects vary based on the risk and sentiment characteristics of the disclosure. In Table 5, we estimate Equation (1) with *CC_OPP_RISK*, *CC_OPP_POS*, and *CC_OPP_NEG*, for firms in the *High CO_2* subsample (columns (1) – (3)) and the *Other* subsample (columns (4) – (6)). *CC_OPP_RISK* is the relative frequency of climate change opportunities bigrams in a sentence that also mentioned the word "risk" or "uncertainty" (or any of their synonyms), while *CC_OPP_POS* and *CC_OPP_NEG* are sentiment measures that count the relative frequency of climate opportunities bigrams occurring in the vicinity of positive and negative tone words (Saunter et al., 2021). We document a significantly positive association between the three-day CARs and all three measures of *CC_OPP*

for the *High CO_2* subsample, suggesting that the market values firms being transparent and honest about their opportunities related to climate change, even when such discussion is accompanied with risk statements and negative tones. This result also suggests that such voluntary disclosure is not merely green washing—it can convey information about a firm's climate change preparedness and its ability to navigate future regulations.

4.3. Cross-sectional Analysis

4.3.1. Climate Disclosure and Market Reaction around the Paris Agreement: The Role of Regulatory Stringency

In this section, we perform an analysis to test whether the effects of climate disclosure on market reaction around the Paris Agreement vary in the cross section. We explore the role of state-level environmental regulatory stringency in moderating the relationship between climate disclosures and investor valuation. Prior studies find that companies located in states with stronger environmental enforcement experience higher climate-related costs and therefore are subject to a higher bar in terms of regulatory compliance (Konisky, 2007; Seltzer et al., 2021). Thus, we expect a stronger impact of climate disclosures on firm value for firms headquartered in such states as they have already been subject to higher environmental standards and thus, may be better prepared to face the new regulations. We test this hypothesis with the following specification:

$$CAR(-1,+1)_i = \beta_0 + \beta_1 CC\_DISCLOSE_i + \beta_2 ENFORCE_i + \beta_3 ENFORCE_i * CC\_DISCLOSE_i + \beta_2 X_i + \delta_k + \varepsilon_i, \quad (2)$$

where *ENFORCE* identifies states where the regulatory stringency level in the year 2015 falls in the top quartile of the distribution and *CC_DISCLOSE* is either *CC_EXPOSURE* or *CC_OPP*. Regulatory stringency is computed following Seltzer et al. (2021) by including enforcement actions related to three key pieces of environmental regulation in the US, the Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act.

Results from estimating Equation (2) are reported in Table 6. The interaction term between *ENFORCE* and our disclosure measures (*CC_EXPOSURE* and *CC_OPP*) is consistently positive and statistically significant for the *High* CO_2 subsample (i.e., Columns (1) – (2)), while no effect is documented for the *Other* subsample (Columns (3) – (4)). Consequently, we infer that consistent with our expectation, climate disclosures are more relevant for companies located in geographic areas subject to stronger environmental regulatory enforcement.

5. Additional Analyses

5.1. Climate Disclosure and Investor Uncertainty around the Paris Agreement

After documenting a positive association between climate disclosures and market reaction for carbon-intensive firms, we further examine whether such disclosures affect investor uncertainty about these firms around the Paris Agreement.

Options' implied volatility has been widely used in prior research to capture investors' uncertainty about firm prospects (Rogers et al., 2009; Truong et al., 2012; Billings et al., 2015; Hann et al., 2019). Its forward-looking nature, data availability, and the fact that it is market-determined make it an appropriate measure to gauge investors' perception of the future stock price fluctuation between the observation and expiration dates. Consequently, we use standardized, 30-day, at-the-money, call and put options to calculate implied volatility before and after the Paris Agreement.[28] We compute the change in investors' uncertainty around the Paris Agreement (i.e., ΔIV) as the difference between the natural logarithm of the firm-level average implied volatility on the day of the Paris Agreement and three trading days after. Then, we estimate the following regression:

[28] Although there are options with varying maturities, the most highly traded correspond to 30-day maturity options and therefore, we use them as the most liquid options traded on the market. They may more accurately capture the uncertainty change around the event day than options with longer maturity. We find qualitatively similar results (untabulated) with 60-day maturity options.

$$\Delta IV_i = \beta_0 + \beta_1 CC\_DISCLOSE_i + \beta_2 PREIV_i + \beta_3 X_i + \delta_k + \varepsilon_i, \quad (3)$$

where $PREIV_i$ is the average level of implied volatility over the three trading days prior to the Paris Agreement, and all the other variables are as defined previously. We expect ex-ante climate disclosures to resolve more investor uncertainty around the regulatory shock, especially for carbon-intense firms (i.e., $\beta_1 < 0$). Table 7 Panel A presents the regression results for the general climate disclosure measure (*CC_EXPOSURE*). As shown in columns (1) – (6), *CC_EXPOSURE* is significantly negative only in the *High* CO_2 subsample. We report the results for *CC_OPP*, *CC_REG*, and *CC_PHY* in Table 7 Panel B. Similar to Table 4, only *CC_OPP* has a significantly negative association with implied volatility. These results complement our findings on stock returns and serve as another piece of evidence for the beneficial effects of climate disclosures (especially discussion of climate-related opportunities): reducing investor uncertainty associated with climate policies and regulations.

5.2. Endogeneity Concerns

Our results are subject to the following potential endogeneity concerns. First, while the adoption of the Paris Agreement was largely unexpected, the timing of the event was known. Therefore, it is possible that firms increased their voluntary climate disclosures before the Paris Agreement to mitigate the anticipated reduction in firm value around the event. We address this concern in two ways. First, given that firms with different level of carbon emissions are likely to be heterogeneously affected by the regulatory shock and that the level of carbon intensity is to a large extent dictated by a firm's industry, we include industry fixed effects to control unobservable variation across industries. Second, we conduct two sensitivity tests in which we exclude *i*) conference calls from the two quarters immediately before the Paris Agreement (as any strategic disclosure to counter the expected reduction in firm value is more likely to take place shortly before

the Agreement) and *ii*) firms that increased their climate disclosure in these two quarters. We find qualitatively similar results (untabulated) for both tests, indicating that our results are unlikely to be driven by firms' anticipatory disclosure choice.

Second, our main measure, *CC_EXPOSURE*, is intended to capture the information conveyed in climate discussions, i.e., the voluntary disclosure of climate change issues. Given the nature of the discussions, however, our measure likely captures some degree of the underlying climate risk exposure. Admittedly, disentangling the disclosed information from the underlying risk exposure is challenging. It is thus possible that our findings are driven in part by the fact that firms with higher exposure to climate events tend to have greater voluntary disclosure. We address this concern in three ways. First, to the extent that climate risk exposure is dictated by industry membership, the inclusion of industry fixed effects should absorb much of the cross-industry variation in climate risk exposure. Second, the heterogeneity in climate risk exposure is arguably smaller within the *High* CO_2 subsample, which is where we find the strongest results. Third, we repeat our main analysis using a smaller sample of firms with carbon emission data. We find qualitatively similar results (untabulated) when we control for the level of carbon emissions. To the extent the intensity of carbon emissions captures an important dimension of climate risk, this result suggests that our main finding is unlikely driven by our measure merely capturing the underlying climate risk.

5.3. Alternative Classification of Carbon-Intense Firms

In this subsection, we use an alternative classification of carbon-intense firms to ensure the robustness of our empirical findings. We rely on the SASB's sustainable industry classification system (SICS) and classify 22 industries as *High* CO_2 industries that include Scope 1 emissions as a disclosure topic. We re-estimate Equation (1) for the two subsamples and report the results in

Table 8. Again, the coefficients on *CC_EXPOSURE* and *CC_OPP* are significant only for the SASB Scope 1 industries subsample. Overall, our empirical results are robust to different classifications of High CO_2 firms.

6. Conclusion

Whether firm-specific disclosure helps investors assess the impact of climate-related regulatory shocks on firm value is a timely and important question that is relevant to the ongoing debate on climate reporting. Despite a long stream of research on questions surrounding climate change, we know little about whether or when qualitative climate disclosure can affect investor expectations. In this paper we use the Paris Agreement as an exogenous shock to climate change policy and examine whether the market rewards those firms that provide greater ex ante disclosure of climate change exposure in their conference calls.

We find that carbon-intense firms with greater pre-meeting climate disclosure experience a less negative stock market reaction around the announcement of the Agreement. This disclosure effect is driven primarily by discussion of climate-related opportunities, which suggests that the content of disclosure matters. We further find that the disclosure effect is more pronounced for firms headquartered in states with more stringent environmental regulation enforcement, which suggests that climate disclosure is more beneficial when the potential impact of new regulations is larger. Taken together, our findings suggest that a firm's climate disclosure is perceived as a positive signal of the firm's climate awareness and ability to navigate the heightened regulatory environment prompted by the Paris Agreement, which ultimately affects the firm's value.

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Figure 1. Timeline

This figure describes the event timeline used in our research design. We compute firms' three-day cumulative abnormal returns around the adoption of the Paris Agreement (i.e., *CAR(–1,+1)*). Our disclosure measures (e.g., *CC_EXPOSURE*, *CC_OPP*) are computed as the average climate-related discussion score over the four calendar quarters of 2015.

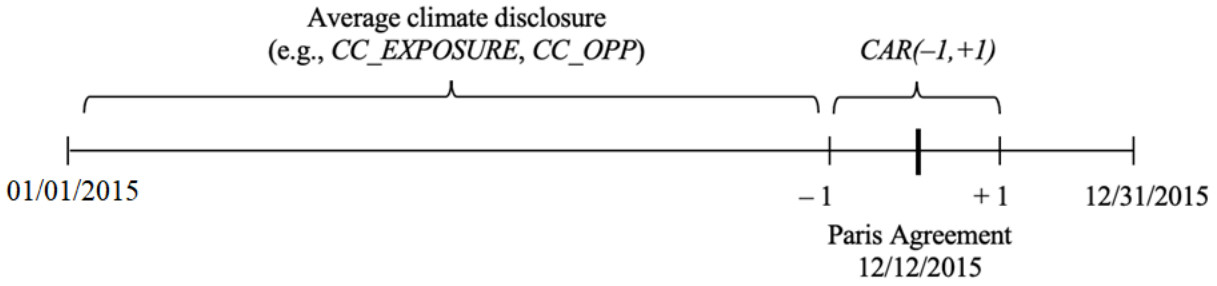

Figure 2. Cumulative Abnormal Returns around the Paris Agreement

Panel A. CARs around the Paris Agreement for *High CO_2* Subsample and *Other* Subsample

This figure plots the cumulative abnormal returns (CARs) over the 45 trading days before the Paris Agreement to 45 trading days after separately for firms in the *High CO_2* subsample and *Other* Subsample, defined based on the level of carbon emission intensity following Ilhan et al. (2021). The *High CO_2* sample includes firms in the following industries (two-digit SIC code): Electric, Gas and Sanitary Services (49), Primary Metal Industries (33), Railroad Transportation (40), Petroleum Refining and Related Industries (29), Stone, Clay, Glass, and Concrete Products (32), Automotive Repair, Services and Parking (75), Oil and Gas Extraction (13), Water Transportation (44), Paper and Allied Products (26), and Transportation by Air (45). The daily abnormal returns are calculated using the Fama-French three-factor model with an estimation window of 200 trading days (from t = -250 to t = -51).

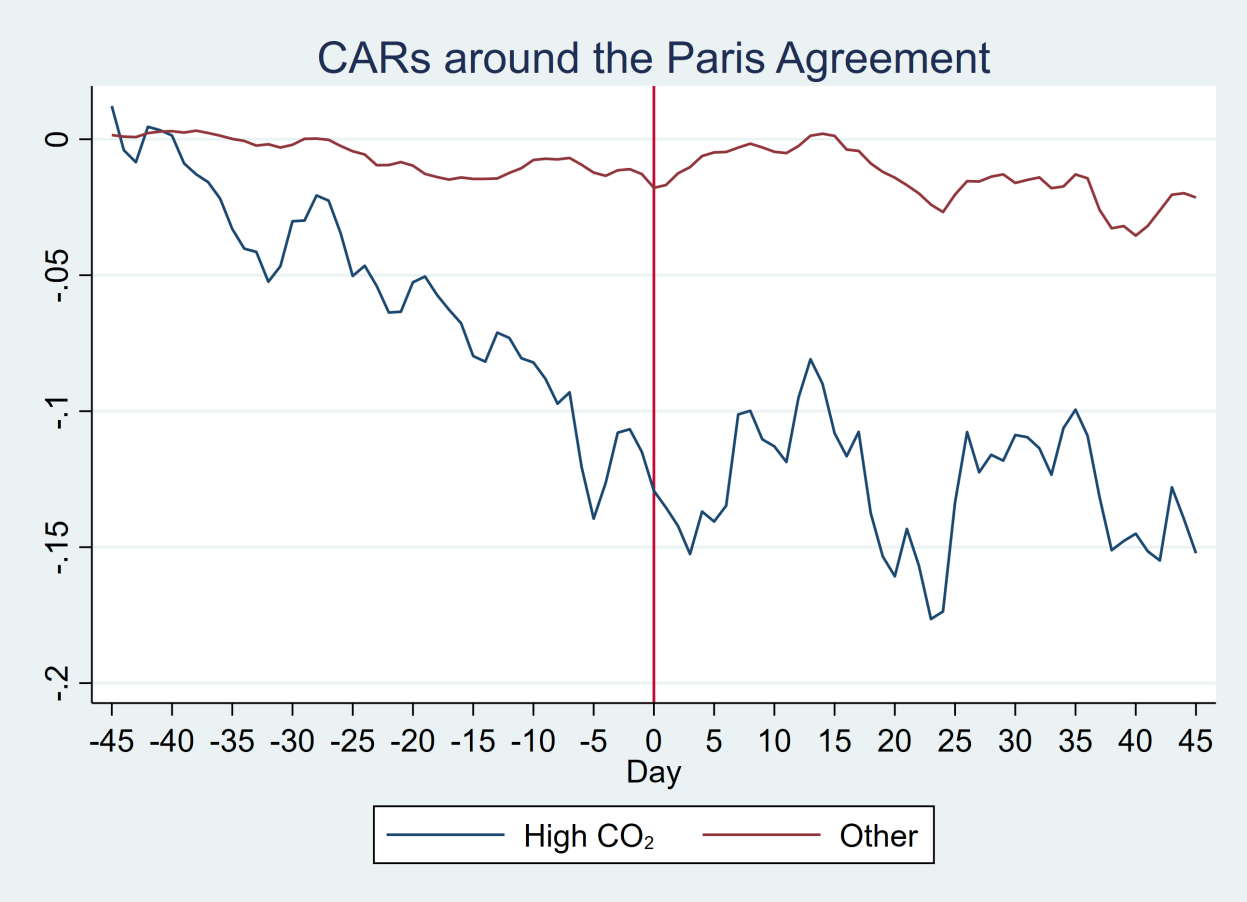

Figure 2, continued

Panel B. CARs around the Paris Agreement for firms with High and Low Climate Disclosure in the *High CO_2* Subsample

This figure plots the cumulative abnormal returns (CARs) over the 45 trading days before the Paris Agreement to 45 trading days after separately for firms with high and low climate disclosure (based on the median value of *CC_EXPOSURE*) in the *High CO_2* subsample. The *High CO_2* subsample includes firms in the following industries (two-digit SIC code): Electric, Gas and Sanitary Services (49), Primary Metal Industries (33), Railroad Transportation (40), Petroleum Refining and Related Industries (29), Stone, Clay, Glass, and Concrete Products (32), Automotive Repair, Services and Parking (75), Oil and Gas Extraction (13), Water Transportation (44), Paper and Allied Products (26), and Transportation by Air (45). The daily abnormal returns are calculated using the Fama-French three-factor model with an estimation window of 200 trading days (from t = -250 to t = -51).

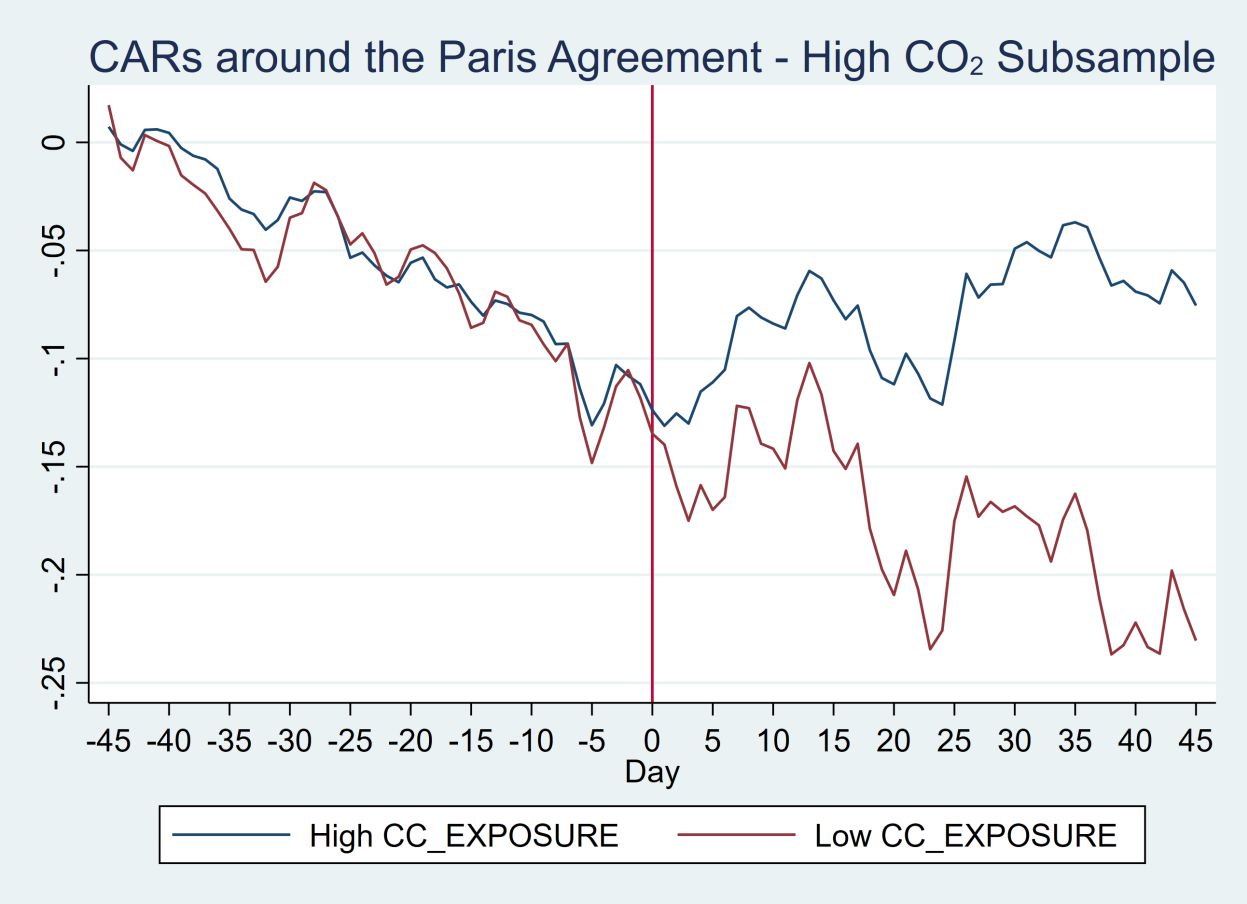

Figure 2, continued

Panel C. CARs around the Paris Agreement for firms with High and Low Climate Disclosure in the *Other* Subsample

This figure plots the cumulative abnormal returns (CARs) over the 45 trading days before the Paris Agreement to 45 trading days after separately for firms with high and low climate disclosure (based on the median value of *CC_EXPOSURE*) in the *Other* subsample. The *Other* subsample includes firms *not* in the following industries (two-digit SIC code): Electric, Gas and Sanitary Services (49), Primary Metal Industries (33), Railroad Transportation (40), Petroleum Refining and Related Industries (29), Stone, Clay, Glass, and Concrete Products (32), Automotive Repair, Services and Parking (75), Oil and Gas Extraction (13), Water Transportation (44), Paper and Allied Products (26), and Transportation by Air (45). The daily abnormal returns are calculated using the Fama-French three-factor model with an estimation window of 200 trading days (from t = -250 to t = -51).

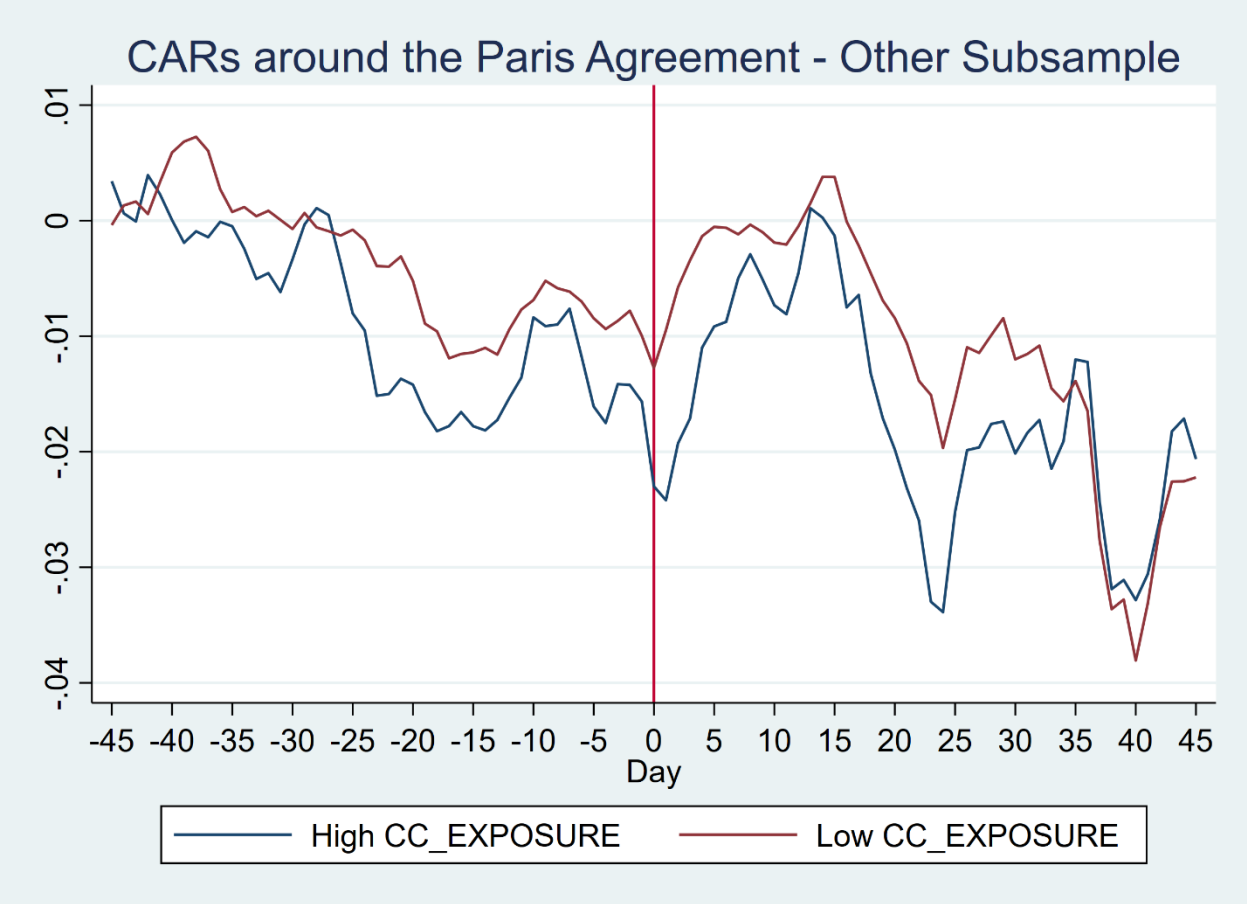

Table 1. Descriptive Statistics

This table reports descriptive statistics for the variables used in our analyses. Panel A presents descriptive statistics for the main variables. Panel B reports Pearson (Spearman) correlations between the variables used in our main regression analyses in the lower (upper) diagonal of the panel. Correlations in bold are significant at the 5% level. All variables are defined in Appendix A.

Panel A. Descriptive Statistics

	N	Mean	Std. Dev.	25th Pctl.	Median	75th Pctl.
CC_EXPOSURE	3,434	0.089	0.213	0.009	0.026	0.067
CC_OPP	3,434	0.035	0.100	0.000	0.007	0.023
CC_REG	3,434	0.004	0.014	0.000	0.000	0.000
CC_PHY	3,434	0.001	0.004	0.000	0.000	0.000
CC_OPP_RISK	3,434	0.001	0.005	0.000	0.000	0.000
CC_OPP_POS	3,434	0.012	0.037	0.000	0.000	0.009
CC_OPP_NEG	3,434	0.011	0.034	0.000	0.000	0.008
CAR(-1,+1)	3,434	-0.009	0.056	-0.027	-0.003	0.016
SIZE	3,434	7.451	2.043	6.026	7.450	8.765
LEV	3,434	0.393	0.329	0.119	0.369	0.578
BTM	3,434	0.518	0.456	0.217	0.418	0.720
CAPINT	3,434	0.134	0.367	0.015	0.034	0.081
ROA	3,434	-0.010	0.199	-0.006	0.029	0.070
FOLLOW	3,434	2.158	0.844	1.609	2.197	2.773
REG_STRING	2,918	0.196	0.397	0.000	0.000	0.000

Table 1, continued

Panel B: Pearson (below the diagonal) and Spearman (above the diagonal) Correlations

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*
CC_EXPOSURE	1	**0.56**	**0.36**	**0.18**	**0.27**	**0.48**	**0.48**	**-0.08**	**0.09**	**0.04**	**0.09**	**0.12**	**0.06**	**0.05**	0.03
CC_OPP	**0.87**	1	**0.27**	**0.07**	**0.37**	**0.75**	**0.73**	**-0.04**	**0.13**	**0.08**	0.03	**0.08**	**0.04**	**0.09**	0.02
CC_REG	**0.64**	**0.48**	1	**0.10**	**0.23**	**0.26**	**0.27**	**-0.05**	**0.09**	**0.06**	0.01	**0.14**	**0.04**	**0.05**	**0.04**
CC_PHY	**0.17**	**0.09**	**0.13**	1	0.00	**0.08**	**0.05**	-0.01	0.03	0.02	**0.05**	-0.01	**0.04**	0.01	0.00
CC_OPP_RISK	**0.53**	**0.58**	**0.29**	0.02	1	**0.36**	**0.42**	0.02	**0.11**	**0.07**	0.03	**0.09**	0.01	**0.05**	0.01
CC_OPP_POS	**0.82**	**0.93**	**0.42**	**0.07**	**0.51**	1	**0.61**	-0.02	**0.10**	**0.07**	0.00	**0.11**	0.02	**0.06**	0.02
CC_OPP_NEG	**0.81**	**0.90**	**0.49**	**0.09**	**0.57**	**0.85**	1	-0.02	**0.13**	**0.06**	**0.07**	**0.07**	0.02	**0.06**	-0.01
CAR(-1,+1)	0.03	**0.06**	-0.02	0.00	**0.05**	**0.06**	**0.05**	1	0.01	**-0.09**	**-0.06**	-0.03	0.01	0.00	-0.03
SIZE	**0.04**	**0.04**	**0.06**	0.00	**0.05**	**0.04**	**0.06**	0.02	1	**0.43**	**0.13**	0.02	**0.25**	**0.61**	**0.10**
LEV	0.03	**0.04**	0.03	0.01	**0.04**	**0.04**	**0.04**	**-0.08**	**0.30**	1	**-0.11**	0.00	**-0.05**	**0.13**	**0.09**
BTM	**0.06**	**0.04**	**0.04**	0.02	**0.04**	0.02	**0.06**	**-0.10**	**0.14**	**-0.17**	1	**-0.13**	**-0.15**	**-0.19**	0.03
CAPINT	**0.05**	**0.06**	0.02	0.00	**0.05**	**0.05**	**0.05**	**-0.12**	-0.02	0.02	**0.14**	1	**-0.05**	**0.25**	0.00
ROA	0.01	0.00	0.02	0.02	0.00	0.00	0.01	0.03	**0.37**	0.03	**0.05**	**-0.17**	1	**0.25**	**0.07**
FOLLOW	**-0.07**	**-0.05**	-0.03	**-0.03**	-0.02	**-0.05**	**-0.05**	0.01	**0.48**	**0.06**	**-0.16**	**0.10**	**0.18**	1	0.00
REG_STRING	-0.01	-0.02	0.03	0.01	0.01	-0.03	-0.01	-0.04	**0.09**	**0.08**	0.02	-0.01	**0.09**	0.01	1

Table 2. Descriptive Statistics by Industry

This table reports descriptive statistics of the main variables used in our analyses disaggregated by industry. Panel A presents descriptive statistics separately for the "*High CO_2*" and "*Other*" subsamples, which are defined based on the level of carbon emission intensity following Ilhan et al. (2021). The *High CO_2* sample includes firms in the following industries (two-digit SIC code): Electric, Gas and Sanitary Services (49), Primary Metal Industries (33), Railroad Transportation (40), Petroleum Refining and Related Industries (29), Stone, Clay, Glass, and Concrete Products (32), Automotive Repair, Services and Parking (75), Oil and Gas Extraction (13), Water Transportation (44), Paper and Allied Products (26), and Transportation by Air (45). Panel B reports the mean value of *CC_EXPOSURE* by 2-digit SIC industry classification. All variables are defined in Appendix A. * and *** denote statistical significance at the 10% and 1% level, respectively.

Panel A. Descriptive Statistics: High CO_2 vs. Other Industries

	High CO_2		*Other*		
Variable	N	Mean	N	Mean	Diff
CAR(-1,+1)	454	-0.029	2980	-0.006	-0.023***
CC_EXPOSURE	454	0.223	2980	0.069	0.154***
CC_OPP	454	0.086	2980	0.027	0.060***
CC_REG	454	0.011	2980	0.002	0.009***
CC_PHY	454	0.001	2980	0.001	0.000*
CC_OPP_RISK	454	0.003	2980	0.001	0.002***
CC_OPP_POS	454	0.030	2980	0.010	0.020***
CC_OPP_NEG	454	0.031	2980	0.008	0.023***

Panel B. Climate-Related Disclosure Scores by Industry (2-digit SIC code)

	INDUSTRY	N	*CC_EXPOSURE*
49	Electric, Gas and Sanitary Services	123	0.638
17	Construction - Special Trade Contractors	7	0.423
16	Heavy Construction, Except Building Construction, Contractor	19	0.296
12	Coal Mining	11	0.280
36	Electronic & Other Electrical Equipment & Components	219	0.206
37	Transportation Equipment	79	0.167
41	Local & Suburban Transit & Interurban Highway Transportation	2	0.159
87	Engineering, Accounting, Research, and Management Services	50	0.157
1	Agricultural Production - Crops	5	0.152
55	Automotive Dealers and Gasoline Service Stations	21	0.148
35	Industrial and Commercial Machinery and Computer Equipment	146	0.140
52	Building Materials, Hardware, Garden Supplies & Mobile Homes	4	0.126
33	Primary Metal Industries	35	0.117
29	Petroleum Refining and Related Industries	33	0.100
99	Non-classifiable Establishments	9	0.099
40	Railroad Transportation	8	0.099
10	Metal Mining	40	0.090
51	Wholesale Trade - Nondurable Goods	43	0.089
78	Motion Pictures	12	0.088
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels	11	0.087
34	Fabricated Metal Products	33	0.081
75	Automotive Repair, Services and Parking	5	0.075
32	Stone, Clay, Glass, and Concrete Products	18	0.067

Table 2, continued

Panel B. Climate-Related Disclosure Scores by Industry (2-digit SIC code)

	INDUSTRY	N	*CC EXPOSURE*
44	Water Transportation	42	0.062
50	Wholesale Trade - Durable Goods	54	0.061
26	Paper and Allied Products	23	0.060
28	Chemicals and Allied Products	313	0.058
13	Oil and Gas Extraction	141	0.056
64	Insurance Agents, Brokers and Service	13	0.051
67	Holding and Other Investment Offices	246	0.051
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	167	0.050
62	Security & Commodity Brokers, Dealers, Exchanges & Services	69	0.049
46	Pipelines, Except Natural Gas	16	0.049
22	Textile Mill Products	7	0.046
20	Food and Kindred Products	64	0.046
45	Transportation by Air	26	0.045
48	Communications	108	0.041
24	Lumber and Wood Products, Except Furniture	14	0.039
65	Real Estate	24	0.038
15	Construction - General Contractors & Operative Builders	21	0.038
30	Rubber and Miscellaneous Plastic Products	17	0.037
72	Personal Services	7	0.036
61	Non-depository Credit Institutions	39	0.036
42	Motor Freight Transportation	12	0.036
60	Depository Institutions	191	0.035
25	Furniture and Fixtures	15	0.035
39	Miscellaneous Manufacturing Industries	13	0.032
54	Food Stores	15	0.031
80	Health Services	45	0.030
63	Insurance Carriers	102	0.030
73	Business Services	415	0.030
47	Transportation Services	11	0.029
53	General Merchandise Stores	15	0.029
79	Amusement and Recreation Services	27	0.028
23	Apparel, Finished Products from Fabrics & Similar Materials	20	0.025
59	Miscellaneous Retail	51	0.025
82	Educational Services	21	0.021
70	Hotels, Rooming Houses, Camps, and Other Lodging Places	13	0.019

Table 3. The Effect of Climate Disclosure on Market Reaction around the Paris Agreement

This table reports regression results of Fama-French Three Factor-adjusted cumulative abnormal returns around the Paris Agreement on climate change disclosures. The first two columns present the full sample effect, while the last four columns partition the sample into two groups: firms from industries with high carbon emission intensities (*High CO_2*) and other industries (*Other*). The sample includes 3,434 firm-level observations in 2015. All variables are defined in Appendix A. *t*-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-1,+1)					
	Full sample		*High CO_2*		*Other*	
	(1)	(2)	(3)	(4)	(5)	(6)
CC EXPOSURE	0.017	0.019	0.054***	0.054***	0.001	0.004
	(1.257)	(1.426)	(11.898)	(17.568)	(0.088)	(0.275)
SIZE		0.003***		0.001		0.002**
		(2.926)		(0.451)		(2.355)
LEV		-0.016***		-0.056*		-0.013***
		(-3.385)		(-1.857)		(-2.671)
BTM		-0.009**		-0.014*		-0.008
		(-2.264)		(-2.076)		(-1.578)
CAPINT		-0.005		-0.011*		-0.001
		(-1.451)		(-1.992)		(-0.272)
ROA		0.007		-0.062		0.010
		(0.678)		(-1.128)		(0.898)
FOLLOW		-0.001		-0.005		0.000
		(-0.557)		(-0.669)		(0.008)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	3,434	3,434	454	454	2,980	2,980
Adj. R-squared	0.069	0.081	0.088	0.114	0.047	0.058

Table 4. The Effect of Climate Disclosure on Market Reaction around the Paris Agreement: Topics of Disclosure

This table reports regression results of Fama-French Three Factor-adjusted cumulative abnormal returns around the Paris Agreement on disclosures about climate change opportunities (*CC_OPP*), regulatory interventions (*CC_REG*), and physical threats (*CC_PHY*). The sample is partitioned into two groups: firms from industries with high carbon emission intensities (*High CO_2*) and other industries (*Other*). The sample includes 3,434 firm-level observations in 2015. All variables are defined in Appendix A. *t*-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-1,+1)					
	High CO_2			*Other*		
	(1)	(2)	(3)	(4)	(5)	(6)
CC_OPP	0.096***			0.044		
	(21.531)			(1.564)		
CC_REG		0.324*			-0.210	
		(1.968)			(-1.663)	
CC_PHY			0.710			0.069
			(1.145)			(0.281)
SIZE	0.002	0.002	0.003	0.002**	0.002**	0.002**
	(0.628)	(0.606)	(0.839)	(2.316)	(2.317)	(2.360)
LEV	-0.058*	-0.054	-0.054	-0.013***	-0.013**	-0.013**
	(-1.929)	(-1.746)	(-1.763)	(-2.882)	(-2.600)	(-2.616)
BTM	-0.014*	-0.014*	-0.014*	-0.008	-0.007	-0.008
	(-2.150)	(-2.010)	(-2.133)	(-1.625)	(-1.506)	(-1.517)
CAPINT	-0.011*	-0.010	-0.010	-0.002	-0.001	-0.001
	(-2.011)	(-1.724)	(-1.725)	(-0.542)	(-0.246)	(-0.236)
ROA	-0.060	-0.062	-0.065	0.010	0.010	0.010
	(-1.099)	(-1.141)	(-1.206)	(0.910)	(0.917)	(0.900)
FOLLOW	-0.007	-0.007	-0.008	0.000	-0.000	-0.000
	(-0.864)	(-0.839)	(-0.937)	(0.088)	(-0.095)	(-0.012)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	454	454	454	2,980	2,980	2,980
Adj. R-squared	0.103	0.0847	0.0779	0.0623	0.0601	0.0581

Table 5. The Effect of Climate Disclosure on Market Reaction around the Paris Agreement: Risk and Sentiments

This table reports regression results of Fama-French Three Factor-adjusted cumulative abnormal returns around the Paris Agreement on disclosures about climate change opportunity risks (*CC_OPP_RISK*), positive (*CC_OPP_POS*) and negative (*CC_OPP_NEG*) tone discussion about climate change opportunities. The sample is partitioned into two groups: firms from industries with high carbon emission intensities (*High CO_2*) and other industries (*Other*). The sample includes 3,434 firm-level observations in 2015. All variables are defined in Appendix A. *t*-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-1,+1)					
	High CO_2			*Other*		
	(1)	(2)	(3)	(4)	(5)	(6)
CC_OPP_RISK	1.295***			0.484		
	(10.047)			(0.812)		
CC_OPP_POS		0.244***			0.102*	
		(12.326)			(1.721)	
CC_OPP_NEG			0.268***			0.104
			(11.520)			(1.504)
SIZE	0.003	0.002	0.002	0.002**	0.002**	0.002**
	(0.865)	(0.591)	(0.650)	(2.319)	(2.321)	(2.316)
LEV	-0.056	-0.058*	-0.058*	-0.013***	-0.013***	-0.013***
	(-1.832)	(-1.975)	(-1.977)	(-2.722)	(-2.746)	(-2.747)
BTM	-0.014*	-0.014*	-0.015*	-0.008	-0.008	-0.008
	(-2.175)	(-2.176)	(-2.045)	(-1.587)	(-1.546)	(-1.636)
CAPINT	-0.011*	-0.011*	-0.011*	-0.001	-0.001	-0.001
	(-2.117)	(-2.138)	(-1.963)	(-0.387)	(-0.443)	(-0.426)
ROA	-0.057	-0.063	-0.065	0.010	0.010	0.010
	(-1.000)	(-1.165)	(-1.201)	(0.921)	(0.910)	(0.895)
FOLLOW	-0.008	-0.008	-0.007	0.000	0.000	0.000
	(-0.929)	(-0.912)	(-0.852)	(0.019)	(0.102)	(0.079)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	454	454	454	2,980	2,980	2,980
Adj. R-squared	0.091	0.102	0.106	0.060	0.061	0.061

Table 6. Cross-sectional Tests on Climate Disclosure and Market Reaction around the Paris Agreement: Environmental Regulatory Stringency

This table reports regression results examining the cross-sectional effect of environmental regulatory stringency on the relationship between climate disclosures and Fama-French Three Factor-adjusted cumulative abnormal returns around the Paris Agreement. The sample includes 2,918 firm-level observations in 2015. All variables are defined in Appendix A. *t*-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-1,+1)			
	High CO_2		*Other*	
	(1)	(2)	(3)	(4)
CC_EXPOSURE	0.046***		-0.012	
	(10.442)		(-1.493)	
*ENFORCE*CC_EXPOSURE*	0.042***		0.013	
	(3.652)		(0.612)	
CC_OPP		0.107***		0.014
		(17.716)		(0.791)
*ENFORCE*CC_OPP*		0.114***		0.041
		(4.811)		(0.961)
ENFORCE	-0.022	-0.024*	-0.004	-0.002
	(-1.653)	(-1.917)	(-1.356)	(-1.044)
SIZE	-0.001	0.002	0.003***	0.004***
	(-0.266)	(0.422)	(2.754)	(3.517)
LEV	-0.056**	-0.062**	-0.019***	-0.021***
	(-2.881)	(-3.063)	(-4.738)	(-5.620)
BTM	-0.016**	-0.023***	-0.011*	-0.015**
	(-2.681)	(-3.626)	(-1.949)	(-2.332)
CAPINT	-0.009*	-0.007*	0.001	-0.002
	(-2.064)	(-2.115)	(0.430)	(-0.508)
ROA	-0.022	-0.013	0.010	0.016***
	(-0.554)	(-0.348)	(1.669)	(3.219)
FOLLOW	-0.002	-0.007	-0.001	-0.003
	(-0.249)	(-0.888)	(-0.229)	(-0.975)
Fixed Effects	Industry	Industry	Industry	Industry
Observations	344	344	2,574	2,574
Adj. R-squared	0.134	0.198	0.073	0.089

Table 7. The Effect of Climate Disclosure on Investor Uncertainty around the Paris Agreement

This table reports regression results of the three-day change in implied volatility following the adoption of the Paris Agreement (i.e., Δ*IV*) on climate change disclosures. Panel A reports the impact of disclosures about climate exposure on the change in implied volatility. The first two columns present the full sample effect, while the last four columns partition the sample into two groups: firms from industries with high carbon emission intensities (*High CO_2*) and other industries (*Other*). Panel B reports the impact of disclosures about climate-related opportunities, regulations and physical threats on changes in implied volatility separately for the sample partitions *High CO_2* and *Other*. The sample includes 2,333 firm-level observations in 2015. All variables are defined in Appendix A. *t*-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: The effect of climate-related discussion on Implied Volatility

	Δ*IV*					
	Full sample		*High CO_2*		*Other*	
	(1)	(2)	(3)	(4)	(5)	(6)
CC EXPOSURE	-0.035	-0.031	-0.082***	-0.072***	0.007	0.012
	(-1.100)	(-0.996)	(-3.339)	(-4.325)	(0.228)	(0.403)
PREIV	0.021	0.053	0.086***	0.135***	0.002	0.024
	(0.838)	(1.655)	(5.038)	(4.162)	(0.074)	(0.695)
SIZE		0.007***		0.010		0.007**
		(2.677)		(1.216)		(2.239)
LEV		-0.014		-0.048		-0.014
		(-0.973)		(-0.907)		(-0.886)
BTM		-0.029*		-0.027		-0.037*
		(-1.790)		(-0.942)		(-1.793)
CAPINT		0.016		0.005		0.019
		(0.994)		(0.150)		(1.359)
ROA		-0.009		-0.009		-0.017
		(-0.445)		(-0.083)		(-0.826)
FOLLOW		0.005		0.022		-0.000
		(0.531)		(1.206)		(-0.042)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	2,333	2,333	376	376	1,957	1,957
Adj. R-squared	0.005	0.008	0.031	0.029	0.001	0.003

Panel B: The effect of climate-related discussion about opportunities, regulations, and physical threats on Implied Volatility

	ΔIV					
	High CO_2			*Other*		
	(1)	(2)	(3)	(4)	(5)	(6)
CC_OPP	-0.096***			-0.019		
	(-10.382)			(-0.231)		
CC_REG		0.055			0.125	
		(0.144)			(0.352)	
CC_PHY			3.405			-0.800
			(1.216)			(-0.862)
PREIV	0.146***	0.156***	0.157***	0.026	0.025	0.025
	(5.581)	(7.186)	(6.796)	(0.760)	(0.692)	(0.687)
SIZE	0.010	0.009	0.010	0.007**	0.007**	0.007**
	(1.100)	(0.846)	(1.129)	(2.322)	(2.217)	(2.200)
LEV	-0.051	-0.060	-0.057	-0.013	-0.014	-0.013
	(-1.006)	(-1.145)	(-1.167)	(-0.866)	(-0.884)	(-0.871)
BTM	-0.028	-0.030	-0.029	-0.036*	-0.037*	-0.036*
	(-1.017)	(-1.172)	(-1.123)	(-1.765)	(-1.803)	(-1.785)
CAPINT	0.004	0.004	0.004	0.020	0.019	0.019
	(0.118)	(0.112)	(0.144)	(1.455)	(1.397)	(1.382)
ROA	-0.011	-0.007	-0.005	-0.016	-0.017	-0.016
	(-0.103)	(-0.069)	(-0.048)	(-0.795)	(-0.831)	(-0.805)
FOLLOW	0.026	0.028	0.027	-0.001	-0.000	-0.000
	(1.383)	(1.663)	(1.453)	(-0.059)	(-0.053)	(-0.051)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	376	376	376	1,957	1,957	1,957
Adj. R-squared	0.024	0.021	0.025	0.003	0.003	0.003

Table 8. The Effect of Climate Disclosure on Market Reaction around the Paris Agreement: Alternative Sample Partitions using Scope 1 Industries

This table reports the results of robustness tests on the relationship between climate disclosures and Fama-French Three Factor-adjusted cumulative abnormal returns around the Paris Agreement using alternative measures to identify high carbon emission firms. We partition the sample using SASB's sustainable industry classification system (SICS). We classify a firm as High CO_2 if they belong to SICS that include Scope 1 emissions as a disclosure topic, as defined by the SASB. All variables are defined in Appendix A. t-statistics (in parentheses) are calculated using standard errors clustered by industry. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-1,+1)					
	High CO_2			*Other*		
	(1)	(2)	(3)	(4)	(5)	(6)
CC_OPP	0.086***			0.047*		
	(4.578)			(1.721)		
CC_REG		0.124			-0.092	
		(0.405)			(-0.649)	
CC_PHY			0.180			0.117
			(0.404)			(0.611)
SIZE	0.003	0.004	0.004	0.002**	0.002**	0.002**
	(1.441)	(1.627)	(1.666)	(2.349)	(2.343)	(2.393)
LEV	-0.033**	-0.030**	-0.030**	-0.016***	-0.015***	-0.016***
	(-2.436)	(-2.089)	(-2.138)	(-3.570)	(-3.286)	(-3.297)
BTM	-0.007	-0.007	-0.007	-0.012**	-0.011**	-0.011**
	(-0.999)	(-0.988)	(-0.999)	(-2.313)	(-2.180)	(-2.175)
CAPINT	-0.006	-0.006	-0.006	-0.001	-0.000	-0.000
	(-1.085)	(-1.015)	(-1.041)	(-0.321)	(-0.053)	(-0.040)
ROA	0.012	0.009	0.008	0.006	0.006	0.006
	(0.327)	(0.244)	(0.228)	(0.537)	(0.551)	(0.545)
FOLLOW	-0.008*	-0.008*	-0.009*	0.001	0.001	0.001
	(-1.713)	(-1.742)	(-1.850)	(0.360)	(0.287)	(0.301)
Fixed Effects	Industry	Industry	Industry	Industry	Industry	Industry
Observations	698	698	698	2,689	2,689	2,689
Adj. R-squared	0.111	0.091	0.090	0.046	0.042	0.041

Appendix A: Variable Definitions

Variable	Definition
Variables for main tests	
CAR(–1,+1)	The three-day cumulative abnormal returns for firm *i* around the adoption of the Paris Agreement (i.e., $t-1\ to\ t+1$) using the Fama-French three-factor model (Fama and French, 1993).
CC_EXPOSURE	Average firm-level discussion about climate change topics in earnings conference calls over the four calendar quarters of 2015. Firm-quarter-level scores were obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/). Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams (see Appendix B) associated with discussion of climate-related topics at the conference call level and scale it by the total number of bigrams. We obtain these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and average them at the firm level. $$CC\_EXPOSURE = \frac{\sum_{2015} \frac{\#\ clim.chg.\ bigrams}{\#\ total\ bigrams} * 100}{4}$$
CC_OPP	Average firm-level discussion about climate change opportunities in earnings conference calls over the four calendar quarters of 2015. Firm-quarter-level scores were obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/). Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate-related opportunities at the conference call level and scale it by the total number of bigrams. We obtain these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and average them at the firm level. $$CC\_EXPOSURE = \frac{\sum_{2015} \frac{\#\ clim.chg.opportunity\ bigrams}{\#\ total\ bigrams} * 100}{4}$$
CC_REG	Average firm-level discussion about regulation shocks related to climate change in earnings conference calls over the four calendar quarters of 2015. Firm-quarter-level scores were obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/). Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate-related regulatory shocks at the conference call level and scale it by the total number of bigrams. We obtain these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and average them at the firm level. $$CC\_EXPOSURE = \frac{\sum_{2015} \frac{\#\ clim.chg.\ regulation\ bigrams}{\#\ total\ bigrams} * 100}{4}$$
CC_PHY	Average firm-level discussion about physical shocks related to climate change in earnings conference calls over the four calendar quarters of 2015. Firm-quarter-level scores were obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/).

Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate-related physical shocks at the conference call level and scale it by the total number of bigrams. We obtain these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and average them at the firm level.

$$CC\_EXPOSURE = \frac{\sum_{2015} \frac{\#\ clim.chg.physical\ bigrams}{\#\ total\ bigrams} * 100}{4}$$

CC_OPP_RISK Average firm-level discussion about climate change opportunity risk in earnings conference calls over the four calendar quarters of 2015.
Firm-quarter-level scores obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/).
Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate change opportunities in the same sentence as the words *risk*, *uncertainty* or their synonyms at the conference call level and scale it by the total number of bigrams. We obtained these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and match them to our sample and average them at the firm level.

$$CC\_RISK = \frac{\sum_{2015} \frac{\#\ clim.chg.\ opportunity\ bigrams \cap risk\ words}{\#\ total\ bigrams} * 100}{4}$$

CC_OPP_POS Average firm-level positive tone discussion about climate change opportunities in earnings conference calls over the four calendar quarters of 2015.
Firm-quarter-level scores obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/).
Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate change opportunities in the same sentence as positive tone words from Loughran and McDonald (2011) at the conference call level and scale it by the total number of bigrams. We obtained these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and match them to our sample and average them at the firm level.

$$CC\_RISK = \frac{\sum_{2015} \frac{\#\ clim.chg.\ opportunity\ bigrams \cap positive\ words}{\#\ total\ bigrams} * 100}{4}$$

CC_OPP_NEG Average firm-level negative tone discussion about climate change opportunities in earnings conference calls over the four calendar quarters of 2015.
Firm-quarter-level scores obtained from Sautner et al. (2021)'s website (i.e., https://osf.io/fd6jq/).
Sautner et al. (2021) count the occurrence of a comprehensive list of bigrams associated with the discussion of climate change opportunities in the same sentence as negative tone words from Loughran and McDonald (2011) at the conference call level and scale it by the total number of bigrams. We obtained these scores for the four calendar quarters of 2015 (numerator below), multiply them by 100, and match them to our sample and average them at the firm level.

$$CC\_RISK = \frac{\sum_{2015} \frac{\#\ clim.chg.\ opportunity\ bigrams \cap negative\ words}{\#\ total\ bigrams} * 100}{4}$$

HIGH CO_2	An indicator variable equal to one if the firm belongs to one of the 2-digit SIC codes identified by Ilhan et al (2021) in the top 10 ranking of carbon intensity. These include SIC codes 33 (Primary metal industries), 49 (Electric, gas, & sanitary services), 32 (Stone, clay, & glass products), 45 (Transportation by air), 44 (Water transportation), 29 (Petroleum & coal products), 13 (Oil & gas extraction), 40 (Railroad transportation), 26 (Paper & allied products), and 75 (Auto repair, services, & parking). Ilham et al. (2021) compute carbon intensities as the sum of a firm's Scope 1 carbon emissions (i.e., direct emissions from the combustion of fossil fuels or releases along the manufacturing process in metric tons of CO_2) divided by the equity market value in millions $, and rank industries according to the average carbon intensity of the firms in them over their sample period (2009-2016).
Variables for cross-sectional and additional tests	
ENFORCE	Indicator variable equal to one if the state of the company's headquarters is in the top quartile of the distribution of regulatory stringency for the year 2015. State-level regulatory stringency is computed following Seltzer et al. (2021) by counting the number of formal and informal enforcement actions related to the Clean Air Act (CAA), Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA) as reported by the Environmental Protection Agency (EPA), divided by the total number of facilities subject to EPA's enforcement.
ΔIV	Natural log change in firm-level daily average implied volatility from standardized, 30-day, at-the-money, call and put options over the period between the adoption of the Paris Agreement (i.e., t) and the following three days. i.e., $\Delta IV = \ln(\overline{IV}_{t+3}) - \ln(\overline{IV}_t)$.
Control variables	
SIZE	Firm size, measured as the lagged natural logarithm of total assets.
LEV	Leverage, measured as the lagged sum of total debt divided by the lagged sum of total debt plus shareholders' equity.
BTM	The book-to-market ratio, measured as the ratio between the lagged book value per share and the lagged closing price of the firm's common shares outstanding.
CAPINT	Capital intensity, measured as lagged capital expenditures divided by lagged sales.
ROA	Profitability, measured as lagged income before extraordinary items divided by total assets lagged two periods.
FOLLOW	Analyst following, measured as the natural logarithm of one plus the total number of analysts that issued earnings forecast over the lagged fiscal year.
PREIV	The level of implied volatility in the pre-Paris Agreement, measured as the average implied volatility over a three-trading-day period from day -3 to day -1 prior to the Paris Agreement.

Appendix B: Climate Change Bigrams from Sautner et al. (2021)

The following is a list of the top 100 climate change bigrams developed by Sautner et al. (2021). Panel A presents the top 100 climate change exposure bigrams, while Panel B presents the top 100 climate change opportunity bigrams.

Panel A: Climate Change Exposure Bigrams

renewable energy	clean power	build owner	reinvestment act
electric vehicle	energy regulatory	electric grid	invest energy
clean energy	plug hybrid	energy team	green build
new energy	obama administration	world energy	sector energy
wind power	build power	energy application	california department
wind energy	world population	wind capacity	plant use
energy efficient	heat power	transmission infrastructure	friendly product
climate change	light bulb	population center	energy initiative
greenhouse gas	carbon capture	energy reform	issue rfp
solar energy	coastal area	charge station	transmission capacity
clean air	energy star	wind park	close megawatt
air quality	scale solar	produce power	market solar
reduce emission	major design	environmental footprint	business air
water resource	transmission grid	source power	construction megawatt
energy need	energy plant	pass house	rooftop solar
carbon emission	global warm	gas vehicle	application power
carbon dioxide	motor control	plant power	forest land
carbon footprint	battery electric	snow ice	grid power
gas emission	clean water	electrical energy	advance driver
energy environment	combine heat	electric hybrid	northern pass
wind resource	need energy	solar installation	nox emission
air pollution	future energy	connect grid	wind facility
reduce carbon	use water	driver assistance	energy component
president obama	environmental concern	reach gigawatt	vehicle application
battery power	include megawatt	provide clean	emission trade

Panel B: Climate Change Opportunity Bigrams

renewable energy	charge infrastructure	grid technology	cost renewable
electric vehicle	micro grid	geothermal power	vehicle talk
clean energy	grid connect	type energy	vehicle offer
new energy	clean efficient	solar program	customer clean
wind power	carbon free	vehicle development	power solar
wind energy	hybrid technology	energy important	vehicle opportunity
solar energy	generation renewable	install solar	community solar
plug hybrid	energy wind	vehicle battery	energy goal
heat power	battery charge	energy vehicle	vehicle hybrid
renewable resource	gas clean	energy bring	invest renewable
solar farm	vehicle lot	vehicle space	incorporate advance
battery electric	vehicle place	opportunity clean	talk solar
electric hybrid	meet energy	demand wind	ton carbon
reinvestment act	vehicle type	vehicle good	small hydro
issue rfp	vehicle future	medical electronic	base solar
construction megawatt	energy commitment	incremental content	target gigawatt
rooftop solar	electronic consumer	supply industrial	charge network
grid power	expand energy	energy target	capacity generation
recovery reinvestment	gigawatt install	term electric	vehicle add
solar generation	bus truck	power world	vehicle infrastructure
energy standard	ton waste	vehicle small	solar array
sustainable energy	energy research	renewable electricity	energy auction
vehicle charge	focus renewable	wave power	product hybrid
guangdong province	pure electric	carbon neutral	product solar
hybrid car	ev charge	auction new	exist wind

Appendix C: Examples of Conference Call Transcripts

Example 1:

The following excerpt is taken from the conference call held by Allete Inc. on August 4, 2015, and in particular, from an exchange between management and outside analyst Andy Levi during the Q&A portion of the call:

> *"Andy Levi, Avon Capital: Just unrelated to steel, believe it or not. Just on the water side I just want to see just longer term what the strategy is there. Should we expect more acquisitions for you guys to make? Was this a one-off? Are there opportunities to make more acquisitions further out?*
>
> *Steve DeVinck, ALLETE, Inc. - SVP & CFO: Thanks for that question and good morning. This is Steve. First of all, we are very excited about U.S. Water, and Al had mentioned how much we just really believe in the nexus between energy and water. I will say this: we expect organic revenue growth there of between 10% and 15%. As well it is a somewhat fragment of market, so it has the opportunity to do some bolt-on acquisitions to fill a strategic need. That could be geographic. It could be product line. It could be things like that. So we're excited about it and I think you will see growth on both fronts.*
>
> *Alan Hodnik, ALLETE, Inc. - Chairman, President & CEO: Andy, this is Al. I would like (technical difficulty) an additional comment. In the last 24 hours of course the **clean power** plant has gotten the most airplay -- **greenhouse gas**, carbon, and **climate change**. But certainly, just from a regulatory stringency perspective -- drought, water reuse, and conservation, sort of all of that -- when I think of the EPA and the U.S. Water's Active America, when I think of state regulations in California and Colorado with respect to water consumption or reduction in water consumption, it just implies to me and speaks to me about, first of all, the nexus of energy and water. Secondly, that the water, and use of water, reuse of water, and wastewater are going to become enormous issues in the next few years."*

The transcript includes the climate change bigrams "clean power", "greenhouse gas" and "climate change" bolded (see the top 100 list of climate change exposure bigrams in Appendix B). The members of management addressed the analyst's question about future water energy investments.

Example 2:

The following excerpt is taken from the conference call held by NextEra Energy Inc on January 27, 2015, and in particular, during the management presentation made by NextEra Energy's Vice Chairman and CFO, Moray Dewhurst:

> *"The growth in Energy Resources' contribution to adjusted earnings per share of $0.06 for the full year was driven largely by growth in our contracted renewables portfolio, which added $0.29 per share. During the year, we installed roughly 1364 MW of new wind and 265 MW of new solar, making 2014 the strongest year ever for new renewable*

*capacity coming into service. We elected CITCs for roughly 265 MW of solar projects in 2014 compared to approximately 280 MW of projects in 2013. We expect to elect CITCs on roughly 365 MW of new **solar generation** in 2015. Contributions from our existing business were up $0.06 per share year over year. Wind resource for 2014 was slightly above our long-term expectations, following a slightly lower resource in 2013."*

The transcript includes the climate change opportunity bigram "solar generation" bolded (see the top 100 list of climate change opportunity bigrams in Appendix B). The Vice Chairman describes the contribution of their portfolio of renewable energy sources to earnings growth over the quarter and their expectation of future impact in energy generation.

Example 3:

The following excerpt is taken from the conference call held by Allete Inc. on February 17, 2015, and in particular, during the management presentation made by Allete's Chairman and CEO, Al Hodnik:

*"… ALLETE is a growing energy company that provides **sustainable energy** solutions to initiatives at our regulated utility businesses and at our complementary energy infrastructure and related services businesses. Let me now detail for you some of our expectations for 2015. Minnesota Power will continue to execute its EnergyForward initiative, pursue customer growth opportunities, and cost recovery rider approval for qualifying investments, as well as working with regulators to earn a fair rate of return. The EnergyForward initiative is Minnesota Power's strategic plan, as you know, for assuring reliability, protecting affordability, and further improving environmental performance. Significant elements of the EnergyForward plan include wind investments that we have made in North Dakota, the Boswell 4 environmental project to reduce emissions, and planning for the proposed Great Northern Transmission Line to deliver hydroelectric power from northern Manitoba by 2020. In 2015 we expect cost recovery rider revenue will increase due to a full-year impact on the recently completed Bison 4 **wind energy** project and from the continuation of the Boswell 4 environmental retrofit project, in which we expect to spend about $90 million this year. Bison 4 will also generate increased production tax credits in 2015."*

The transcript includes the climate change bigrams "sustainable energy" and "wind energy" bolded which identify discussion about both, climate change exposure and opportunities (see the top 100 list of climate change bigrams in Appendix B). The Chairman described the firm's investments intended to produce clean energy solutions and boost environmental performance.

Example 4:

The following excerpt is taken from the conference call held by Eversource Energy on November 03, 2015, and in particular, during the management presentation made by Allete's Executive Vice President (EVP), Lee Olivier:

"… Additionally, as part of our Forward New Hampshire plan, we announced our intent to provide $200 million of support to the state over the next 20 years to support important initiatives in tourism, economic development, community investment, and ***clean energy innovation****, should Northern Pass be built and placed into operation. We've had a very positive reaction to the Forward New Hampshire plan, which has now been endorsed by a wide range of business, labor and political leaders, both state and municipal in New Hampshire. We've had a very positive reaction to the Forward New Hampshire plan, which has now been endorsed by a wide range of business, labor and political leaders, both state and municipal in New Hampshire. We held five public meetings on the project in the state in early September and filed our siting application with the New Hampshire Site Evaluation committee on October 19. The filing highlights the significant direct benefits the project will bring to New Hampshire, which we estimate to be more than $3 billion. They include $80 million per year of lower energy costs over the next 10 years, $30 million per year of increased property tax revenues, and $2 billion of increased economic activity, driven in part by the creation of 2,400 jobs during the construction period. The benefits also include reducing the regions* ***carbon emissions*** *by approximately three million tons per year. We have illustrated that the carbon reduction requirements of the three states we serve on slide 11. The challenge the region faces meeting those requirements were made more difficult last month, when Entergy announced it will retire the Pilgrim nuclear power plant no later than June of 2019. That shutdown, in and of itself, is expected to increase* ***carbon emissions*** *by two million to three million tons a year. The closure of Vermont Yankee nearly a year ago increased* ***carbon emissions*** *by a similar amount. This is a particular issue for Massachusetts, which is targeting a* ***greenhouse gas emissions*** *goal of 71 million tons by 2025, a reduction of 23 million tons from the 94 million tons emitted in 1990. Massachusetts plans to achieve 10 million tons of that reduction from the electric power sector and more than half of that is expected to come from the new* ***clean energy*** *sources such as Canadian hydropower. But the state's efforts will clearly be challenged by the impact of Pilgrim's retirement. Governor Baker filed legislation this past summer that calls on the state to purchase up to 18.9 million-megawatt hours annually of clean hydroelectric power and other* ***renewable energy****. That equates to about 2,400-megawatts of capacity. He personally testified on behalf of the bill in September. We will closely monitor its progress. All of these developments point to the significant need the region has for Northern Pass. It would represent the largest single new source of clean, firm power available to the region."*

The transcript includes the climate change bigrams "carbon emissions" (three times), "greenhouse gas", "energy innovation", and "gas emissions" bolded ,which identify discussion about climate change exposure, while the bigrams "clean energy" (twice) and "renewable energy" (bolded) identify discussion about both climate change exposure and opportunities (see the top 100 list of climate change exposure bigrams in Appendix B). The EVP described capital investments intended to produce clean energy and the competitive position of the firm amidst the different energy challenges faced by northern US states.

Example 5:

The following excerpt is taken from the conference call held by NextEra Energy Inc on January 27, 2015, and in particular, during the management presentation made by NextEra Energy's President, Armando Pimentel:

> *"So a couple of things. First, we are on a -- I know we give you these numbers on a quarterly basis, but we are on what I would consider a pretty decent roll with our development activities in the renewables side. So over the last couple of years, we have signed long-term power purchase agreements for wind and solar that are just above 2900 megawatts. Of that 2900, Moray pointed out in the slides this morning that some of those were built in 2014, but we've still got 2115 -- I believe the number is -- of megawatts for contracts that we have in hand that will go COD in 2015 and 2016. That number does not include any potential for wind projects in 2016. We believe that the IRS is going to provide similar guidance on this PTC as they did last time. We hope that will be provided before the investor conference in March, and at the time we will share with you what our expectations are on the wind side. But it clearly would be a giant disappointment if we have 0 MW in 2016. I just do not think that is going to happen. On the solar front, really over the last 12 to 18 months, we have done very well in that market. I think it is still way too early to talk about what is going to happen with tax credits for solar beyond 2016. And as such, we probably have just a couple of more quarters here where we and others will be able to sign folks up for long-term agreements on the solar side. But we've got several very promising opportunities on the solar side that I hope will pan out. To give you an indication, though, of what we have been doing, 2014 was also our highest ever year in terms of bringing* ***renewable energy*** *megawatts to COD. In 2014 we brought 1630 MW of COD, so we clearly have the capabilities to do that. And I hope we would do that. I am certainly not committing to that, but we will have more information for you in March."*

The transcript includes the climate change bigram "renewable energy" bolded which identifies discussion about both climate change exposure and opportunities (see the top 100 list of climate change bigrams in Appendix B). The President described the firm's development and opportunities for energy generation using renewable energy sources, especially solar energy.

Example 6:

The following excerpt is taken from the conference call held by American Electric Power Company Inc. on October 22, 2015, and in particular, during the management presentation made by NextEra Energy's Chairman, Nicholas Akins:

> *"I'm reminded that yesterday October 21, 2015 was back to the future day, the day that Marty McFly and Dr. Emmett Brown time-traveled into the future from the 1989 sequel to Back to the Future. When we look back at1989 and where we are today, during that*

time AEP has reduced SO2 emissions by over 80%, NOX emissions by over 80%, Mercury emissions by over 54%, and CO2 emissions since 2005 levels of 15%. More recently we have to deployed battery storage technology, the BOLD transmission line, utility and ***rooftop solar****, and now embark on the infrastructure of the future to define a better customer experience. These are all examples of Back to the Future's version of hoverboards and self-tying sneakers, but all of this is to say that we believe AEP is uniquely positioned both financially and culturally to be successful during this huge transition that is occurring within our industry. We will continue to focus on infrastructure development technology and resources of the future and a renewed focus on the customer experience. Our investors expect consistency and quality of earnings and dividend growth, so any decision we make should be viewed through the lens of being the next premium regulated utility."*

The transcript includes the climate change bigram "rooftop solar" bolded which identifies discussion about both climate change exposure and opportunities (see the top 100 list of climate change bigrams in Appendix B). The Chairman described the firm's Advances in the reduction of greenhouse and other damaging gases as well as changes in the company to transition toward a low carbon economy.