Global Finance Journal 53 (2022) 100739

Contents lists available at ScienceDirect

Global Finance Journal

journal homepage: www.elsevier.com/locate/gfj

Do climate risk beliefs shape corporate social responsibility?☆

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ARTICLE INFO

Keywords:
Climate change beliefs
Corporate social responsibility
ESG scores
Natural disasters

ABSTRACT

Global climate change is one of the most pressing issues of our time, potentially affecting everyone, both individuals and businesses. This paper examines whether differences in beliefs about climate change affect firms' decision-making in Corporate Social Responsibility (CSR) commitment. Using county-level climate change beliefs data from Yale Climate Opinion Maps, we find that firms' Environmental, Social, and Governance (ESG) scores are higher if they are located in counties where more people believe in global climate change. We then use natural disasters as exogenous shocks to the beliefs about climate risk and continue to find a positive association between CSR and perceptions of climate risks. Furthermore, we discover a stronger correlation between CSR and climate risk beliefs when firms have more local investors.

1. Introduction

Global climate change has significant negative impacts on the U.S. economy and poses a great risk to individuals and businesses. According to a major scientific report by 13 federal agencies in 2018, global warming could affect the U.S. economy by as much as 10% by the end of the century if no substantial actions are taken.[1] Financial research also reveals how climate change can affect a firm's or government's cost of doing business or an individual's property value.[2] What can firms do to mitigate the potential impacts of the climate change risks? Corporations' engagements in Corporate Social Responsibilities (CSR), such as improving their environmental sustainability activities and reducing carbon emissions, are great ways to counter the negative impacts of global climate change. Improving firms' ESG scores can be a useful tool for the business community in combating the negative impacts of global climate change.

However, not all firms respond uniformly to climate change. Many people, in particular, remain skeptical of global climate change and may not believe in the negative consequences of climate risks. The beliefs in climate change could play a significant role in their decision-making process, both in their personal lives and in the context of businesses. For example, Baldauf, Garlappi, and Yannelis (2020) find that, although sea-level rise has negative impacts on housing prices, its effects depend on whether or not people in the area

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[1] Based on "U.S. climate report warns of damaged environment and shrinking economy", New York Times, November 23, 2019.

[2] For example, Dessaint and Matray (2017), Painter (2020), and Bernstein et al. (2019).

https://doi.org/10.1016/j.gfj.2022.100739
Received 30 March 2022; Received in revised form 20 April 2022; Accepted 5 May 2022
Available online 12 May 2022

believe in climate change. Bakkensen and Barrage (2021) use survey data and discover that flood risk beliefs affect housing prices in Rhode Island. Choi, Gao, and Jiang (2020) find that traders' climate risk beliefs can affect their trading behaviors. Li, Lin, Jin, and Zhang (2020) discover that climate risks can affect a firm's employment and investment decisions, with the effects being stronger in areas where climate change believers are more prevalent. Therefore, we hypothesize that people's beliefs about climate risk could affect a firm's decision in improving CSR activities to combat climate change. Firms might be more likely to improve their ESG scores if they locate in areas where more people believe in climate change.[3] On the other hand, firms' actions in CSR activities might have nothing to do with a greater belief in climate risks. Rather, firms might improve their ESG scores only to benefit the business itself, such as to reduce the cost of capital, lower idiosyncratic risks, increase firm value, or attract investors.[4] In this case, we expect that changes in firms' ESG scores do not correlate with beliefs about climate risks. Therefore, in this paper, we attempt to determine whether managers' decisions to increase CSR commitments are influenced by climate risk beliefs. If beliefs do play a role, policymakers may be able to improve firm engagement in CSR-related activities by raising awareness of climate risks or persuading more people to believe in global climate change.

Using county-level climate change beliefs data from Yale Climate Opinion Maps, we find that firms in areas with higher beliefs have higher ESG scores. Each one standard deviation increase in climate risk beliefs is associated with a 0.43% increase in ESG scores, which corresponds to a 2.4% increase in the mean ESG scores. The results are also strong when we focus on the environmental or social component of ESG scores. Our findings are consistent with the notion that managers are more likely to take actions in ESG to contribute to the societal good in the environment or to hedge potential climate risks when they live in the areas with more climate risk believers.

One concern with the climate risk beliefs data from Yale is that it represents the average beliefs in the county, which may not necessarily represent firm managers' beliefs in climate risks. To assess whether they are interconnected with each other, we obtain a firm-level climate risk sentiment measure from Sautner et al. (2021) to proxy for firm managers' climate risk sentiment and test if it correlates with county-level climate risk beliefs. We discover that climate risk belief is significantly correlated with firm-level climate risk sentiment. Furthermore, we use climate risk sentiment in place of climate risk beliefs and test whether it affects a firm's ESG scores. We find that coefficients on the climate risk sentiment are significantly positive, although they are weaker than when we use climate risk beliefs.

Although our findings on the relationship between climate change beliefs and ESG scores pass a series of robustness tests, there may still be concerns over endogeneity issues, such as some omitted variables that may affect both factors. For example, executives who are more concerned about ESG issues might be more inclined to locate their headquarters in areas where the climate change concept is more widely accepted. To address potential endogeneity concerns, we examine an exogenous event, namely natural disasters, that could affect climate change beliefs within a firm over a certain time. Choi et al. (2020) find that people's attention and beliefs about climate change are affected by global warming or higher temperatures. We believe that natural disasters such as hurricanes or flooding can alter people's attention and change their beliefs about climate change. Our findings indicate that people's perceptions of climate risk change significantly after a natural disaster occurs in the previous period.

When we use natural disasters as a proxy for changes in climate change beliefs, we find consistent results that firms increase their ESG scores after a natural disaster strikes. Firms also improve their ESG scores more when the damage from the disasters is greater. In addition, the effects are stronger when the disasters hit areas with higher levels of belief. The results indicate that disasters and climate change beliefs reinforce each other and both contribute to firms making more CSR-related commitments.

The results are consistent with literature that show the effects of surrounding environments on firms' decision-making, including local climate policies (Ramelli, Wagner, Zeckhauser, & Ziegler, 2021), cultural (Ho, Wang, & Vitell, 2012), and religious environments (Cui, Jo, & Velasquez, 2015). We further explore a more direct connection between firms and local communities, namely local institutional investors. Institutional investors are believed to drive improvements in CSR for stocks they hold (Chen, Dong, & Lin, 2020; Dyck, Lins, Roth, & Wagner, 2019), because they are more likely to voice their concerns and push for changes in CSR-related policies. We hypothesize that one of the channels through which local climate change beliefs influence firms' CSR commitments is through institutional investors who are located in the local areas and thus have similar levels of beliefs as the firms.

We believe that when firms have more local institutional investors, local climate change beliefs should have a greater impact on their ESG scores. By separating samples into two groups of firms with or without local investors, we find that the relationships between climate change beliefs and ESG scores are only significant when local investors are present. It indicates that local communities' beliefs, especially those of local institutional investors, have a strong impact on firms' decision-making on CSR commitments.

The paper adds to the growing body of research on how climate change affects business and government decision-making. For example, Dessaint and Matray (2017) show that firm managers overreact to hurricane strikes by holding cash above the optimal level. Painter (2020) finds that sea-level rise affects the price of municipal bonds in coastal cities. In addition, Bernstein, Gustafson, and Lewis (2019) discover that global warming has a negative impact on house values in areas prone to sea-level rise.

This paper also contributes to the broad climate finance literature that studies the interaction between climate change and finance, specifically how climate change beliefs affect financial decision-making. Most extant literature focuses on the relationship between beliefs and personal financing, such as how beliefs affect housing prices (Bakkensen & Barrage, 2021; Baldauf et al., 2020), mortgage filings (Duan & Li, 2019), and demand for flood insurance (Ratnadiwakara & Venugopal, 2020). Li et al. (2020) provide a connection

[3] We use the climate risk beliefs in the county as a proxy for firm managers' beliefs. In subsequent tests, we examine how county climate risk beliefs are associated with firm level climate risk sentiments and find the two factors to be highly correlated.

[4] See Cao, Titman, Zhan, and Zhang (2020), Deng, Kang, and Low (2013), Fernando, Sharfman, and Uysal (2017), Kruger (2015), and Lins, Servaes, and Tamayo (2017).

between beliefs and corporate finance decision-making in their employment and investments. They find that climate change, higher abnormal temperatures, in particular, is associated with firms' reduction in local employment and establishments. They conclude that when firms are in counties where people believe in climate change, the results are stronger. Our paper makes the contribution in showing the association between beliefs and a firm's CSR investments.

Furthermore, our paper is related to the string of literature on the determinants of CSR scores. CSR scores appear to be shaped by corporate governance, scandals, ownership disparities, and managers' personal values (Arvidsson, 2010; Choi, Jo, Kim, & Kim, 2018; Hemingway & Maclagan, 2004; Jo & Harjoto, 2012). Our finding is more closely associated with literature that finds that firms' CSR activities are affected by surrounding environments, such as local religious beliefs (Cui et al., 2015; Cui, Jo, & Velasquez, 2016; Du, Jian, Zeng, & Du, 2014), and cultural and geographic environments (Ho et al., 2012). We discover a new CSR determinant that is related to the environments in which the managers live: climate change beliefs.

Lastly, our results are consistent with the literature that connects institutional investors with CSR performance. Literature indicates that institutional ownership and the taste of institutional investors drive firms to improve their CSR commitments (Dyck et al., 2019; Hwang, Titman, & Wang, 2021). Krueger, Sautner, and Starks (2020) find that institutional investors care about climate risk and, in a related paper, Ilhan, Jrueger, Sautner, and Starks (2019) find that institutional investors demand a higher level of climate risk disclosures. We find that local institutional investors have a significant impact on a firm's choice in CSR commitments.

The remainder of the paper is organized as follows: Section 2 reviews the relevant literature and develops the hypotheses that we further test in Section 4. Section 3 describes the databases we combined for the empirical tests. Section 4 presents the empirical results to formally test our hypotheses. Section 5 concludes.

2. Literature review and hypothesis development

While climate change has significant impacts on economies and firm activities, people's beliefs in climate risks play a significant role in determining their actions. Li et al. (2020) discover that firms reduce their employments and establishments when the areas experience abnormal long-term temperature rises. However, the effects are much more significant when the climate change beliefs are higher. Similar to their findings regarding the beliefs, a number of other recent literature have found that differences in beliefs have various effects on people's lives. For example, Choi et al. (2020) show that individual's belief about climate change could lead to behavioral-biased trading in the stock market, which could cost them financially. Krueger et al. (2020) survey global institutional investors and find that they take climate risk seriously and proactively engage in climate risk management in their portfolio investments. In addition, Baldauf et al. (2020) find that the beliefs determine the price of houses that are projected to be underwater. When the percentage of climate change believers increases by one standard deviation, the price drops by 7% for underwater houses. Bakkensen and Barrage (2021) use survey data in Rhode Island and find that the flood risk perceptions significantly affect house prices. Ratnadiwakara and Venugopal (2020) discover the connection between climate change beliefs and the demand for flood insurance. Lastly, Duan and Li (2019) find that concerns about climate change affect the mortgage approval rates and loan amounts, and the effects are stronger when more people believe in climate change. Overall, these studies show that climate change beliefs have major financial implications.

To our knowledge, no extant literature has examined whether firms are more or less environmentally responsible when there are more people in the area believes in climate change. We are interested in studying firms' overall corporate social responsibility (CSR) or their environmental responsibility, as both are believed to play a role in hedging climate risk. Engle, Giglio, Kelly, Lee, and Stroebel (2020) find that long-short portfolios consisting of firms with high and low ESG scores are able to hedge the innovations in climate news. They believe that when there is a negative shock in climate change news, high ESG firms can perform much better than the low ESG firms, and thus provide a hedge to the climate risks. If firm managers are more likely to believe that climate change is an imminent risk, they might take actions to combat or hedge the climate risk, through the mean of increasing firms' ESG scores. That leads to our first hypothesis:

Hypothesis 1. If firm managers are more likely to believe in climate change risks, we expect firms to have higher ESG scores and/or environmental scores.

The null hypothesis is that ESG scores of firms in which managers have higher beliefs in climate change would be no different or lower than those of firms with lower beliefs. Here, we use the percentage of people who believe in climate change in the local communities as a proxy for the managers' beliefs.

We believe that there exists a correlation between ESG scores and local climate change beliefs, as extant literature finds that community or local environments/beliefs can shape firms' decisions, especially in terms of ESG commitment. Both Cui et al. (2015) and Du et al. (2014) find that local religious beliefs are associated with firms' ESG contributions. Cui et al. (2015) find a negative correlation between Christian religiosity and management's decision in environmental practices. However, Du et al. (2014) find that firms' corporate environmental disclosure scores are positively associated with Buddhism religiosity using data from China. In addition, Cui et al. (2016) find a connection between community religion and a firm's performance in social aspects. Ho et al. (2012) use the global data and find that culture and geographic environments are significantly associated with a firm's CSR performance. The testing of our hypothesis will complement the string of literature that examines how the impact of firms' external environments affect their decision-making in ESG improvements.

One problem with examining the correlation between ESG scores and climate change beliefs is that the beliefs are relatively sticky, and the within-firm variation might not be significant. We need an exogenous event that is associated with climate change beliefs and can affect firms' decision-making in ESG scores. Ramelli et al. (2021) use 2016 Trump's election as a shock to the U.S. climate change

policy and find that long-term investors appear to reward firms with climate response strategies. Although the 2016 election result provides a useful shock to the climate change beliefs, we are more interested in events that might affect different firms differently at different times. Therefore, we turn to a series of exogenous events that happen at different locations during various times and are believed to be associated with beliefs, namely natural disasters.

We use natural disaster events as a proxy to the change in climate change beliefs because physical climate change events such as natural disasters and rising temperatures appear to affect people's perception of climate risks. Choi et al. (2020) observe a change in people's beliefs about climate change when they experience abnormally high temperatures. Natural disasters such as hurricanes can affect firm managers' decision-making and sometimes could cause them to make sub-optimal choices in an attempt to combat possible future disasters (Dessaint & Matray, 2017). Abnormal high temperatures also appear to affect firms' decisions in various ways, such as employment and investments (Li et al., 2020) and mortgage lending (Duan & Li, 2019). Pankratz and Schiller (2019) combine the temperatures and flooding events as shocks to firms' perception of climate change risks and find that the climate shocks affect firms' decision-making in adjusting their supply chain choices. The literature is consistent with our assumption that physical climate change-related events can play a role in altering people's beliefs in climate change. We propose to use the natural disaster events as a shock to the climate change beliefs and make our second hypothesis:

Hypothesis 2. If firm managers experience a shock to the changes in climate change beliefs, such as experiencing a natural disaster event, firms will more likely increase their ESG scores and/or environmental scores.

While natural disasters provide shocks to people's beliefs in climate change, the effects might be asymmetric between high and low believers. In addition, the disasters and beliefs might reinforce each other, meaning disasters might have stronger impacts on areas with higher beliefs and weaker impacts on areas with lower beliefs. Therefore, we broaden Hypothesis 2 to include the following:

Hypothesis 2a. The effect of disasters on a firm's decision-making in ESG improvement is stronger in areas with stronger beliefs about climate change.

Moreover, the degree of a shock to climate change beliefs depends on how big the shock is provided by the disasters. There could be a meaningful difference in impacts between disasters that provide greater shocks or damages to the community and those with fewer damage. Therefore, we further hypothesize:

Hypothesis 2b. The effect of disasters on a firm's decision-making in ESG improvement is stronger in areas with higher disaster-related damage.

While local climate change beliefs have a significant impact on firm managers, they can also affect a firm's local shareholders. There is a group of important shareholders that we can locate and determine whether or not they are local investors, namely institutional investors. Institutional investors play an important role in the firms' decision-makings, especially in terms of ESG investments. For example, Dyck et al. (2019) use global data and find that institutional investors drive firms' environmental and social performance. Hwang et al. (2021) find that firms react to higher ownership from socially responsible institutions by increasing their CSR scores. Krueger et al. (2020) use the survey data and find that institutional investors are increasingly concerned about climate change risks and start to take proactive risk management measures. The ownership of institutional investors as a whole is a vital determinant of firms' CSR commitments, however, in our study, we would like to focus on the role of local investors since we are interested in the impact of local climate beliefs by the investors. We believe that the effect of climate change beliefs on CSR varies depending on whether or not local investors are present. This leads to our third hypothesis:

Hypothesis 3. The relationship between beliefs and CSR is affected by the presence of local institutional investors.

We predict climate change beliefs to have a greater impact on CSR rankings when local investors are present. In Section 4, we further test all the above-mentioned hypotheses.

3. Data

We compile the data used in this paper from the following five sources.

3.1. Beliefs about climate change

We follow Baldauf et al. (2020) and measure beliefs about climate change using Yale Climate Opinion Maps. The survey provides county-level data on questions about how people perceive climate change risk. We measure the beliefs about climate change (variable name: Belief) using the percentage of people who answer "YES" to the question: whether they believe that climate change is happening.[5]

[5] We obtain the belief data from three years of surveys (2014, 2016, and 2018). To construct panel data for firms in those counties, we expand the 2014 survey results to cover the year 2013 and before. We use the 2016 and 2018 survey results to cover the years 2015 and 2017, respectively.

3.2. ESG scores

We measure a firm's corporate social responsibility (CSR) commitment using environmental, social, and governance (ESG) disclosure scores from Bloomberg Data Service (Bloomberg). Bloomberg covers ESG scores for over 11,500 companies in 83 countries in 2019. Bloomberg ESG scores rate firms annually on a scale of 0 to 100 based on the quality of policy-related ESG data. It covers 120 environmental, social, and governance indicators including carbon emissions, climate change effect, diversity, community relations, human rights, independent directors, and many more. Several aspects covered by Bloomberg are particularly relevant to our research question regarding local climate change beliefs, such as climate change effect and community relations. Therefore, in this paper, we mainly use Bloomberg ESG score as a proxy for a firm's efforts on CSR commitment and focus on U.S. public firms that covered by Bloomberg. Bloomberg starts providing ESG data from 2006, and that is the start year of our sample.

There are numerous ESG data providers. Besides Bloomberg, another data provider, MSCI ESG Research, which provides commonly known KLD ESG scores, is also widely used in the literature. In one of the robustness tests, we replace Bloomberg score with KLD scores and find similar results.[6]

3.3. Firm financial variables

We obtain a firm's annual fundamental variables from Compustat and stock return information from CRSP. Our industry classification follows the Fama-French 48 industry categories. We follow Harjoto, Jo, and Kim (2017) in constructing the control variables. In all regression models, we control for return on assets, the standard deviation of daily return for the firm-year, market to book ratio, RD expense ratios, total assets, number of analysts following the company, Herfindahl-Hirschman Index, total debt ratio, cash flow ratios, and industry median ESG scores. Summaries on the definitions of all variables can be found in the Appendix A.

To merge firms with climate change beliefs data at the county level, we also extract firms' headquarter addresses from Compustat. We use the Environmental Systems Research Institute (ESRI)'s ArcGIS Pro to geocode the addresses and then apply the spatial join to match each address to its corresponding county using the unique county ID. After matching and cross-referencing firms with both ESG scores and climate change beliefs data, we end up with 1254 firms and 9024 firm-year observations from year 2006 to 2018.

3.4. Climate risk sentiments

We obtain firm-level climate risk sentiments data from Sautner et al. (2021).[7] They use a machine learning technique to look for keywords in the earning calls that are related to climate change risks, and create multiple measures to proxy for the climate risk that firms face. We adopt one of their measures, climate risk sentiments, to assess how concerned managers are about the climate risk. The data include 10,158 firms between 2002 and 2019.

3.5. Natural disasters

We obtain the natural disaster data from the Spatial Hazard Events and Losses Database for the United States (SHELDUS) maintained by the Center for Emergency Management and Homeland Security at Arizona State University (CEMHS, 2018). The dataset covers various types of natural disasters over the past few decades in the United States. We are interested in using natural disasters as an exogenous shock to people's perceptions of climate risk, thus we focus on three types of natural disasters that are more climate change-related: flooding, hurricanes/tropical storms, and tornadoes. We aggregate the property damage from these three major types of natural disasters by each county year. We use county Id to cross-reference with data on ESG and climate change beliefs.

3.6. Institutional investor equity holdings and addresses

We use 13F institutional investor stock holding data from Thomson Reuters to study local institutional ownership. All institutional investment managers that have over $100 million of assets under management need to file Form 13F with the Securities and Exchange Commission (SEC). We obtain the quarterly equity holdings by institutional investors to calculate the ownership by local investors.

Further, we identify the institutional investors' addresses to match with firms' addresses. We acquire institutional investors' addresses from another mandatory SEC filing, Form ADV. Investment advisers are required to register with the SEC and file a Form ADV each year or when there are any material changes. The ADV filings are publicly available on the SEC's Investment Adviser Public Disclosure (IAPD) website. Investors' addresses can be found in Item 1F from Part 1 of ADV filings. We do not require firms and institutional investors to be located in the same county; rather, investors are considered local if their addresses are within 100 miles of the firms' headquarters. The percentage of local ownership is calculated by dividing the aggregated shares held by local investors by the total number of shares outstanding of the firm in each quarter. We further define local ownership as the average of quarterly local ownership over the year.

[6] At the time of writing, KLD only provides ESG scores for academic researchers up to 2016. Therefore, we use Bloomberg ESG score for our main results as the data are more up to date, and provide robust results using KLD scores.

[7] We download the data from https://doi.org/10.17605/OSF.IO/FD6JQ. We thank the authors for making the data available.

4. Empirical results

4.1. Descriptive statistics

In this section, we report the summary statistics of variables used in the regression of ESG scores on climate change belief. In Panel A of Table 1, we report the summaries for our key variable, Belief, in 2014, 2016, and 2018 when Yale Climate Opinion Maps provide estimates on American's climate change beliefs at the county level. Across three years that we have data on, we find an increasing trend in Belief. On average, there are about 72% of believers, however there are large variations across counties. For example, at the 5th percentile, only 61% of the population believe in global climate change, while about 83% believe in it at the 95th percentile.

In Panel B, we report the summaries for ESG scores and control variables. The mean and standard deviation of the ESG score is about 17.8 and 10.5, respectively. The mean values of environmental (ENV) and social (SOC) scores are very close to ESG scores, but with a higher variation. The ENV score can range from 1.6 to 29 from the 5th percentile to the 95th percentile. The average governance (GOV) score is 51.6 but with much less variations (the standard deviation is 6). Given that the ESG score is an equal-weighted composite of ENV, SOC, and GOV ratings, we expect the biggest variation in ESG to come from either the variation in ENV or SOC scores. We follow prior literature in constructing all control variables. The summaries of control variables show no out-of-ordinary departure from the previous literature. The mean market-to-book ratio is about 2.9, and the debt ratio is about 23%. We notice that the industry median ESG score is 12.8, which is lower than the median ESG score of 14 for overall firms. This indicates that our sample is slightly over-weighted by firms in lower ESG industries.

Table 2 reports Pearson correlations among those variables. The correlation matrix indicates that Belief is significantly correlated with ESG scores and all three component scores. The correlation coefficients between ESG and its three component scores are high as expected. Most of the correlation coefficients among control variables are less than 0.5, which mitigates the potential concerns on multicollinearity.

4.2. Climate change belief and ESG

4.2.1. Regression results

Our main research question is whether climate change beliefs affect firms' choices in becoming more transparent and making efforts to improve ESG scores. In this subsection, we test the correlation between ESG scores and climate change beliefs in a regression setting, where we control for variables that affect ESG scores. In Table 3, we report the results on the regression of ESG scores and each of its three component scores on climate change beliefs. We include industry and time fixed effects across all models to control for potential time trends and across industry differences in ESG scores. All continuous, independent variables are standardized to mean of zero and a standard deviation of one. In Model 1, the result indicates that a one standard deviation increases in Belief, firms' ESG scores increase by 0.43, about a 2.4% increase over mean ESG scores. The effects of Belief on ENV and SOC scores are in a similar magnitude to that on ESG scores. However, we do not find a significant correlation between Belief and GOV scores. The result on GOV scores is not unexpected, as we believe that climate change belief is more likely to be associated with a firm's commitment to overall ESG or environmental issues than on the governance issues.

4.2.2. Robustness tests

In this subsection, we explore different sample periods and different ways of constructing the Belief variable and ESG scores to examine the robustness of our main findings. As Yale Climate Opinion Maps only provide climate change belief data since 2014, we have to backdate the belief data to 2006, apply the survey results in 2014 for all years proceeding it. Although the climate change belief data across different years is very persistent, one might still worry about the accuracy of belief data applied to the year 2013 and before. The coefficient for pairwise correlation between one year's climate change belief and any of the other two years' data is 0.76, and it is highly significant. In Model 1 of Panel A in Table 4, we drop observations before 2014 and continue to find a significant coefficient on Belief. Our results are robust when we restrict the sample with more reliable Belief data.

In Model 2, we adjust ESG scores by industry median value and find that the results are similar to that in our main specification. Instead of using the continuous Belief variable, in Model 3, we use the High Belief dummy that takes one if it is higher than the median Belief value. The result indicates that firms have a higher ESG score of about 1.2 if they locate in above-median Belief areas, after holding all control variables constant. We argue that firms are more likely to take initiatives in ESG activities if they happen to locate in areas with higher climate change beliefs. However, one might believe that firms that are interested in higher ESG investment choose to move to the high Belief areas. Therefore, in Model 4, instead of using firms' Belief value at any given year, we use the firms' Belief value at the time of the founding. Most firms were founded prior to 2014 and arguably may not have a clear picture as to where more people believe in climate change are located by the time Yale Climate Opinion Maps were released. Our result is also robust when using the Belief value at the time of the founding.

Although we have controlled for various variables that are believed to be correlated with ESG scores, we might still face potential omitted variables biases. For example, the managers' political beliefs might be correlated with climate risk beliefs, and at the same time, they could affect firms' ESG scores. To understand whether the political view in the area is contributing to the relationship we observed between climate risk beliefs and ESG scores, we interact the Belief with a Democratic party dummy, which takes 1 if the state has a Democratic governor and 0 otherwise. The result is presented in Column 5. The coefficient on the interaction term is insignificant and only the Belief variable remains significant. Therefore, we believe that the relationship between Belief and ESG scores is independent of political influences.

Table 1
Summary statistics.

Panel A. Percentage of Climate Change Believers

Year	mean	sd	p5	p25	p50	p75	p95
2014	67.9	6.2	58.0	64.0	68.0	73.0	80.0
2016	74.1	5.6	63.7	71.0	74.3	79.2	83.0
2018	74.7	5.8	64.1	71.4	75.0	78.4	83.7
Total	72.3	6.6	61.0	68.0	72.9	77.6	83.0

Panel B. Summary Statistics for ESG Scores and Other Control Variables

	mean	sd	p5	p25	p50	p75	p95
ESG Score	17.81	10.47	11.16	11.84	14.05	17.77	43.77
ENV Score	17.33	17.09	1.55	2.33	10.85	28.97	51.16
SOC Score	16.13	12.99	3.33	8.33	13.33	19.30	43.86
GOV Score	51.57	5.95	46.43	48.21	51.79	51.79	62.50
ROA	−0.04	0.25	−0.54	−0.02	0.02	0.06	0.15
Standard Deviation	0.03	0.02	0.01	0.01	0.02	0.03	0.06
Market to Book	2.87	5.32	0.18	1.07	1.80	3.29	10.05
RNDR	1.14	6.19	0.00	0.00	0.04	0.17	2.71
Log Asset	6.59	2.11	3.01	5.15	6.63	8.00	10.14
Log Number of Analyst	1.88	0.97	0.00	1.39	1.95	2.64	3.33
HHI Index	333.45	586.41	36.01	64.78	122.47	251.74	1480.50
Debt	0.23	0.23	0.00	0.03	0.16	0.36	0.68
Cash Flow	0.02	0.20	−0.37	0.01	0.06	0.11	0.22
Industry Median ESG	12.81	1.84	11.14	11.84	11.84	14.05	16.27

This table presents the summary statistics on climate change beliefs and firm characteristics. In Panel A, we report the statistics on the percentage of people in a county who believe that global warming is happening, based on the survey data reported by Yale Climate Opinion Maps. In Panel B, we report the annual ESG disclosure scores, as well as its three component scores, namely environmental, social, and governance scores for firms covered by Bloomberg. The sample period is 2006 to 2018. The detailed definition of the rest of the variables can be found in Appendix A.

Even though we include time-fixed effects in our model to control for potential impact from a certain time trend, one might still be concerned about whether the measures across different years are comparable. For example, one might argue that the way survey questions on climate change are asked or perceived by people might vary during different years, or Bloomberg makes some systematic changes to how they calculate ESG scores during different years. To alleviate such potential concerns, we use the standardized value of Belief and/or ESG scores by year to obtain a relative ranking of a firm's Belief or ESG scores in a given year. By standardizing them, we also make the variables more comparable across different years. In Model 6, we report the result of the regression of ESG scores on standardized Belief. In Model 7, we replace the dependent variable to be standardized ESG scores. Across both models, we continue to find similar results on the correlation between ESG scores and Belief.

Lastly, there are various providers that collect ESG scores for firms. Besides Bloomberg ESG scores, academic research also use KLD CSR scores. In Model 8, we use KLD CSR scores as dependent variables and find a highly significant coefficient on Belief (with a t-stat of 5.0). In Panel B, we replace ESG scores with ENV scores.[8] We find the coefficients on Belief to be significant across all models.

4.3. Firm level climate risk estimates – climate risk sentiment

With the climate risk beliefs data from Yale, one concern is that it represents the average beliefs in the county, which might not be correlated with firm managers' beliefs in climate risks. To understand whether managers' beliefs are correlated with the county's average climate risk belief, we use a firm-level climate risk sentiment measure developed by Sautner et al. (2021) to proxy for firm managers' climate risk sentiment and test if they are correlated. In Model 1 of Table 5, we regress firm-level climate risk sentiment on climate risk beliefs and control for the firm level variables, along with firm and time fixed effects. The coefficient on climate risk sentiment is positive and highly significant, indicating that the county level measure of climate risk beliefs is highly correlated with the firm level measure. We believe that the climate risk beliefs could be a reasonable proxy for firm level beliefs on climate risk. Therefore, next, we use the firm level climate risk sentiment in place of climate risk belief and test if it is correlated with ESG scores. From Models 2 to 4 in Table 5, we find significant and positive coefficients on climate risk sentiments when the dependent variables are ESG, ENV, and SOC scores, although the results are weaker when compared to the climate risk beliefs results. The coefficient is insignificant when we use the GOV score as the dependent variable.

[8] The results are also robust for SOC scores, but they are not reported here for brevity.

Table 2
Pearson correlations.

	Belief	ESG Score	ENV Score	SOC Score	GOV Score	ROA	SD	MB	RNDR	Log AT	Analyst	HHI Index	Debt	CF	Med. ESG
Belief	1														
ESG Score	0.0907*	1													
ENV Score	0.0857*	0.9741*	1												
SOC Score	0.0857*	0.8864*	0.7528*	1											
GOV Score	0.0723*	0.7775*	0.6732*	0.6380*	1										
ROA	−0.0220*	0.0873*	0.0435*	0.0741*	0.0854*	1									
Standard Deviation	−0.1594*	−0.2220*	−0.2031*	−0.2121*	−0.2056*	−0.0607*	1								
Market to Book	0.0042	−0.0036	0.005	0.0015	−0.0036	0.0746*	0.0037	1							
RNDR	0.0147*	−0.0157	−0.0244	−0.0068	−0.0146	−0.0642*	0.0241*	−0.0003	1						
Log Asset	0.0207*	0.5387*	0.4951*	0.4207*	0.4515*	0.0350*	−0.3881*	−0.0183*	−0.0281*	1					
Log Number of Analyst	0.0781*	0.4487*	0.4114*	0.3689*	0.3675*	0.0172*	−0.2277*	−0.0076	−0.0102	0.5733*	1				
HHI Index	−0.0212*	0.0451*	0.0806*	0.0276*	0.0278*	0.0068	−0.0151*	−0.0011	−0.0095	0.2016*	0.1482*	1			
Debt	0.0297*	0.0954*	0.0601*	0.0999*	0.0676*	−0.4236*	0.0251*	−0.0002	0.0545*	0.0504*	0.0745*	0.0035	1		
Cash Flow	−0.0472*	0.1186*	0.0771*	0.1000*	0.1126*	0.6843*	−0.2601*	−0.0109*	−0.0874*	0.1894*	0.1412*	0.0381*	−0.5104*	1	
Industry Median ESG	0.1371*	0.3192*	0.0805*	0.2767*	0.2762*	0.0063	−0.0814*	0.0003	−0.0115	0.2434*	0.1546*	0.4035*	0.0267*	0.0417*	1

This table presents the pairwise Pearson correlations between two of the variables that are defined in Table 1. * represents that the correlation is significant at 5% level.

Table 3
ESG score and climate change beliefs.

	1	2	3	4
	ESG Score	ENV Score	SOC Score	GOV Score
Belief	0.4304***	0.4681***	0.6280***	0.0343
	[3.577]	[2.956]	[4.297]	[0.500]
ROA	−11.6184***	−13.8116***	−12.7804***	−4.2899**
	[−5.009]	[−4.842]	[−4.281]	[−2.438]
Standard Deviation	−0.5570**	−0.5770**	−0.5090*	−0.5525***
	[−2.502]	[−2.108]	[−1.786]	[−3.777]
Market to Book	0.0026	0.0180***	−0.0282***	−0.0008
	[0.458]	[2.737]	[−3.741]	[−0.221]
RNDR	0.0482**	−0.0270	0.2313***	0.0373***
	[2.318]	[−0.718]	[13.592]	[2.723]
Log Asset	7.8601***	9.9853***	7.8222***	3.2827***
	[40.462]	[38.914]	[35.792]	[25.387]
Log Number of Analyst	0.6417***	0.5138***	1.2120***	0.2275***
	[5.026]	[3.153]	[7.779]	[2.624]
HHI Index	0.0233	0.0050	0.0014	0.0967
	[0.208]	[0.034]	[0.010]	[1.398]
Debt	−2.0726***	−2.5558***	−1.8436***	−1.0667***
	[−7.580]	[−7.017]	[−5.911]	[−5.873]
Cash Flow	0.3127	−0.3500	1.2413	0.2344
	[0.460]	[−0.410]	[1.425]	[0.469]
Industry Median ESG	0.9579***	1.1700***	1.0924***	0.3462***
	[6.687]	[6.338]	[6.205]	[5.001]
Observations	9024	9024	9024	9024
R-squared	0.475	0.432	0.446	0.349

This table reports the results of regressions of ESG scores, as well as its three components scores, on climate change beliefs. The unit of observation is a firm-year. All variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and time fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

4.4. Natural disasters and ESG

Given the limitation of Yale Climate Opinion Maps which does not cover the data before 2014, our previous results mainly focus on cross-sectional differences among firms, since most of our data on Belief are static across time series. In this section, we explore time-varying events that can affect climate change beliefs and further affect the firm's ESG scores, namely natural disasters. First, we use the periods between 2014 and 2018 when we can observe a change in Belief and test if the change in Belief is associated with the happening of natural disasters. In Panel A of Table 6, we discover that the Belief variable increases by 2.2% between two years if no natural disasters happen, and it increases by 6.4% when disasters strike, a 200% higher. A *t*-test of the difference in change in Beliefs also shows it to be highly significant (t-stat = 18.63). In Panel B, we further run a regression of Climate Risk Belief on the happening of natural disasters and the amount of damage caused by natural disasters, along with a county and year fixed effects. The regression results also indicate a significant and positive correlation between natural disasters and Belief. The results are consistent with our prior belief that people's perceptions of climate change are affected by their experience of extreme natural disasters that are associated with climate change.

Next, in Table 7, we use the happening of natural disasters as proxies for changes in climate change beliefs and test if firms' ESG scores are affected by such a time-varying proxy.[9]

In the regression models in Table 7, we replace the independent variable as the dummy that indicates whether firms have experienced a natural disaster before. The After Natural Disasters dummy takes the value of one if it is after a firm hit by disasters, and zero otherwise. For firms that have never experienced a disaster during our sample periods, the value of the dummy is zero across the whole time series. As a result, our regression setting takes a difference-in-difference approach and tests how firms' ESG scores change after firms hit by disasters, relative to firms not hit by disasters. Besides, we add a firm fixed effect to examine the time-varying effects on ESG scores within a firm.

We use ESG scores and their three component scores in each of the four models, and find that the coefficients on the natural disaster dummy are all significantly positive. It indicates that firms have higher ESG scores after experiencing disasters. The results echo with the climate change belief results and point to the channel where firm managers' decisions on ESG are affected by how they or the communities they locate at perceive climate change.

If natural disasters represent an exogenous shock to people's beliefs in climate change, then we should expect the shock to be stronger when the damage from disasters is higher or if it comes from areas with more believers. In Table 8, we test the hypothesis that

[9] Huang, Li, Lin, and McBrayer (2022) discover a similar result in the correlation between the happening of natural disasters and ESG scores, however, their paper focuses on using firm's nearby disasters as a shock to the impact of ESG.

Table 4
ESG score and climate change beliefs - robustness tests.

Panel A. Robustness tests for ESG Scores

	1	2	3	4	5	6	7	8
	ESG Score							
	Years≥ 2014	ESG adjusted	Belief Dummy	Belief at Founding	State Party	Standardized Belief	Standardized ESG	KLD CSR Score
Belief	0.4647***	0.4211***			0.5177***		0.0420***	0.0737***
	[2.757]	[3.500]			[3.422]		[3.630]	[4.996]
High Belief			1.1966***					
			[6.195]					
Belief at Founding				0.4304***				
				[3.577]				
Democratic Party					0.0512			
					[0.256]			
Democratic Party * Belief					0.0026			
					[0.012]			
Belief (Standardized by year)						0.3807***		
						[3.554]		
ROA	−11.1921***	−11.5366***	−11.5719***	−11.6184***	−11.3232***	−11.6251***	−1.1333***	−0.7266**
	[−3.561]	[−4.986]	[−5.003]	[−5.009]	[−4.835]	[−5.014]	[−5.088]	[−2.074]
Standard Deviation	−0.0717	−0.5257**	−0.5728***	−0.5570**	−0.5416**	−0.5566**	−0.0570***	−0.0598**
	[−0.238]	[−2.364]	[−2.584]	[−2.502]	[−2.418]	[−2.501]	[−2.634]	[−2.064]
Market to Book	0.0094	0.0038	−0.0002	0.0026	0.0031	0.0026	0.0002	0.1895
	[1.511]	[0.631]	[−0.037]	[0.458]	[0.533]	[0.453]	[0.450]	[1.429]
RNDR	0.0629**	0.0535***	0.0454**	0.0482**	0.0460**	0.0478**	0.0047**	0.1258**
	[2.357]	[2.842]	[2.263]	[2.318]	[2.143]	[2.287]	[2.350]	[2.050]
Log Asset	8.5819***	7.7885***	7.8317***	7.8601***	7.9107***	7.8611***	0.7573***	0.4145***
	[31.754]	[39.661]	[40.487]	[40.462]	[40.503]	[40.472]	[40.604]	[15.243]
Log Number of Analyst	0.9770***	0.6506***	0.6244***	0.6417***	0.6352***	0.6412***	0.0597***	0.1428***
	[5.604]	[5.045]	[4.899]	[5.026]	[4.930]	[5.021]	[4.866]	[8.574]
HHI Index	−0.1530	0.0783	0.0288	0.0233	−0.0265	0.0223	0.0003	0.0372**
	[−0.620]	[0.679]	[0.257]	[0.208]	[−0.230]	[0.198]	[0.032]	[2.560]
Debt	−1.8118***	−2.0409***	−2.0223***	−2.0726***	−2.1090***	−2.0730***	−0.2024***	−0.2002***
	[−5.351]	[−7.474]	[−7.443]	[−7.580]	[−7.664]	[−7.582]	[−7.701]	[−5.479]
Cash Flow	−1.0891	0.2939	0.3331	0.3127	0.2315	0.3158	0.0303	0.3403***
	[−1.277]	[0.431]	[0.491]	[0.460]	[0.337]	[0.464]	[0.463]	[3.238]
Industry Median ESG	0.9714***		0.9643***	0.9579***	0.9383***	0.9589***	0.0909***	−0.0027
	[3.351]		[6.719]	[6.687]	[6.504]	[6.695]	[6.600]	[−0.184]
Observations	5176	9024	9024	9024	8926	9024	9024	4630
R-squared	0.499	0.417	0.477	0.475	0.474	0.475	0.467	0.347

Panel B. Robustness tests for ENV Scores

	1	2	3	4	5	6	7	8
	ENV Score							
	Years≥ 2014	ENV adjusted	ENV Score	ENV Score	State Party	ENV Score	ENV (Standardized)	KLD ENV Score
Belief	0.6669***	0.6508**			0.6147***		0.0369***	0.0085**

(*continued on next page*)

Table 4 (*continued*)

Panel B. Robustness tests for ENV Scores								
	1	2	3	4	5	6	7	8
	ENV Score							
	Years≥ 2014	ENV adjusted	ENV Score	ENV Score	State Party	ENV Score	ENV (Standardized)	KLD ENV Score
	[2.979]	[1.975]			[3.064]		[2.994]	[2.457]
Belief (above median)			1.4234***					
			[5.587]					
Belief (when founded)				0.4681***				
				[2.956]				
Democratic Party					0.3193			
					[1.209]			
Democratic Party * Belief					−0.2675			
					[−0.930]			
Belief (Standardized by year)						0.4220***		
						[2.989]		
ROA	−13.4884***	−5.9867	−13.7170***	−13.8116***	−13.5491***	−13.8110***	−1.1051***	−0.1682**
	[−3.568]	[−0.427]	[−4.817]	[−4.842]	[−4.699]	[−4.843]	[−4.963]	[−2.015]
Standard Deviation	0.0961	−1.0296	−0.5967**	−0.5770**	−0.5668**	−0.5768**	−0.0484**	−0.0085
	[0.263]	[−1.146]	[−2.188]	[−2.108]	[−2.058]	[−2.108]	[−2.243]	[−1.150]
Market to Book	0.0269***	−1.9842	0.0146**	0.0180***	0.0187***	0.0180***	0.0016***	0.0036
	[3.754]	[−1.377]	[2.201]	[2.737]	[2.804]	[2.732]	[3.143]	[0.129]
RNDR	−0.0063	259.3184***	−0.0308	−0.0270	−0.0273	−0.0275	−0.0019	−0.0011
	[−0.141]	[5.442]	[−0.837]	[−0.718]	[−0.709]	[−0.729]	[−0.663]	[−0.142]
Log Asset	11.0895***	10.3693***	9.9487***	9.9853***	10.0632***	9.9859***	0.7795***	0.1082***
	[30.514]	[19.539]	[38.905]	[38.914]	[38.948]	[38.925]	[39.111]	[18.228]
Log Number of Analyst	0.8438***	2.1912***	0.4901***	0.5138***	0.4971***	0.5126***	0.0377***	0.0158***
	[3.759]	[5.021]	[3.013]	[3.153]	[3.013]	[3.145]	[2.970]	[3.698]
HHI Index	−0.0195	0.1161	0.0105	0.0050	−0.0535	0.0036	−0.0021	0.0035
	[−0.058]	[0.398]	[0.072]	[0.034]	[−0.355]	[0.024]	[−0.180]	[1.002]
Debt	−2.3451***	0.5128	−2.4919***	−2.5558***	−2.5981***	−2.5554***	−0.2020***	−0.0418***
	[−5.113]	[0.554]	[−6.884]	[−7.017]	[−7.090]	[−7.017]	[−7.145]	[−5.213]
Cash Flow	−2.2140**	6.4710*	−0.3259	−0.3500	−0.4333	−0.3466	−0.0259	0.0505**
	[−2.073]	[1.859]	[−0.382]	[−0.410]	[−0.503]	[−0.406]	[−0.389]	[2.026]
Industry Median ESG	1.2437***		1.1774***	1.1700***	1.1451***	1.1711***	0.0873***	0.0065*
	[3.153]		[6.360]	[6.338]	[6.170]	[6.344]	[6.143]	[1.916]
Observations	5176	3413	9024	9024	8926	9024	9024	4615
R-squared	0.454	0.297	0.434	0.432	0.432	0.432	0.430	0.303

This table reports the results of regressions of ESG scores in Panel A, and ENV scores in Panel B, on climate change beliefs. The unit of observation is a firm-year. In Model 1, we include only sample periods between 2014 and 2018. In Model 2, we adjust the dependent variable by subtracting it from the industry median value. In Model 3, we replace the Belief variable to be a dummy indicating whether Belief is higher than the median value during the year. In Model 4, we use the Belief data at the location that the firm was founded as the main independent variable. In Model 5, we interact the Belief variables with Democratic Party dummy which takes one when the state has a Democratic governor. In Model 6, we standardize the Belief by each year. In Model 7, we standardize the ESG (in Panel A) or ENV score (in Panel B) by each year. In Model 8, we replace the ESG score with KLD CSR score provided by MSCI ESG Research. All other variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and time fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

Table 5
Climate risk sentiment and ESG scores.

	(1)	(2)	(3)	(4)	(5)
	Climate Risk Sentiment	ESG Score	ENV Score	SOC Score	GOV Score
Belief	0.0464**				
	[2.096]				
Climate Risk Sentiment		0.0863*	0.0969*	0.1077*	0.0225
		[1.799]	[1.667]	[1.679]	[1.099]
ROA	−0.2625	−12.8815***	−16.0580***	−13.0414***	−4.0909*
	[−0.896]	[−4.661]	[−4.751]	[−3.660]	[−1.878]
Standard Deviation	−0.0717***	−0.8060***	−0.9205***	−0.6688**	−0.7173***
	[−2.638]	[−3.368]	[−3.120]	[−2.106]	[−4.516]
Market to Book	0.0330	−1.5254	−1.3986	−2.2408	−1.1684*
	[1.549]	[−1.207]	[−0.895]	[−1.485]	[−1.828]
RNDR	0.0554**	−0.8251***	−1.3873***	0.2193	−0.5978
	[2.403]	[−3.181]	[−3.704]	[0.713]	[−1.230]
Log Asset	−0.0319	8.2455***	10.4779***	8.2413***	3.4280***
	[−1.523]	[41.026]	[39.341]	[36.127]	[25.221]
Log Number of Analyst	−0.0431**	0.9470***	0.8567***	1.5299***	0.3275***
	[−2.175]	[6.610]	[4.688]	[8.746]	[3.371]
HHI Index	−0.0104	0.0428	0.0278	0.0217	0.1046
	[−1.116]	[0.371]	[0.183]	[0.150]	[1.467]
Debt	0.0908**	−2.3368***	−2.8429***	−2.0823***	−1.2245***
	[2.014]	[−8.093]	[−7.348]	[−6.232]	[−6.377]
Cash Flow	0.1866*	0.1086	−0.4988	0.8131	0.0797
	[1.827]	[0.144]	[−0.525]	[0.836]	[0.142]
Industry Median ESG	0.0162	0.9661***	1.1822***	1.1009***	0.3475***
	[1.378]	[6.661]	[6.320]	[6.183]	[4.938]
Constant	0.0523**	14.9867***	2.5466***	7.7752***	50.2999***
	[2.059]	[62.534]	[8.188]	[25.501]	[357.649]
Observations	8446	8446	8446	8446	8446
R-squared	0.018	0.483	0.440	0.451	0.357

This table reports the results of regressions of climate risk sentiment on the climate risk beliefs, as well as regressions of ESG scores, as well as its three components' scores, on climate risk sentiment. The unit of observation is a firm-year. All other variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and firm fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

the effects of disasters on ESG scores differ between high and low belief areas, and between high and low damage disasters.

In Models 1 and 2, we run the same regression as in Table 7 for ESG scores, but with a subsample of firms in high and low Belief areas, respectively. We calculate the Belief value within a firm across all periods and define a firm to be in a high (low) Belief area if its Belief value is higher (lower) than the median value. Both models show significant coefficients of the natural disaster dummy, indicating that the disasters have an effect on the firm's ESG scores for either low or high Belief areas. The coefficient on disasters is higher for high Belief areas than that for low Belief. To test if the difference is statistically significant, we use an interaction between the disaster dummy and the Belief dummy in Model 3 and include firms in high and low Belief areas and firms both hit and not hit by disasters in the sample.[10] The coefficient on the interaction term is positive and highly significant. That means when a disaster strike area with more believers, firm managers increase their ESG scores after the disaster, and the increase is higher than the rest of the areas and higher than firms not hit by disasters. The results are consistent with our hypothesis that natural disasters and climate change beliefs reinforce each other and both show a positive impact on ESG scores.

Further, if people's perceptions are affected by disasters, then the degree of changes in beliefs should be influenced by the amount of damage caused by disasters. We separate samples by the amount of property damage from the disasters and report the regression results using a high (low) damage sample in Model 4 (5). Both models show significant coefficients on disaster dummy, but the coefficient on the model using high damage subsample is much higher than that using low damage subsample. In Model 6, when we include all samples and interact high damage dummy with disaster dummy, the interaction term is highly significant as expected.[11]

In Panel B, we repeat the regression models in Panel A but replace the dependent variable with ENV scores. The results are quantitatively similar to that in Panel A. Combining both results, we conclude that natural disaster events along with local climate change beliefs have a profound impact on firms' commitments to environmentally friendly activities, and further help improve firms' ESG scores along the process.

[10] The lower term of High Belief is dropped from the model due to the perfect collinearity with firm dummy.
[11] The lower term of High Damage is dropped from the model due to the perfect collinearity with firm dummy.

Table 6
Natural disaster and climate risk beliefs.

Panel A. Changes in Belief by natural disaster events		
Natural disaster events	Changes in Belief	N
No	2.221	5949
Yes	6.411	337
Yes-No	4.191	–
t-stat	18.63	–

Panel B. Regression of Climate Risk Beliefs on Disaster Strikes		
	1	2
	Climate Risk Beliefs	
After Natural Disasters	0.4502***	
	[7.009]	
Disaster Damage Amount		0.0295**
		[1.963]
Observations	6284	6284
R-squared	0.976	0.975

The panel A in this table compares the average change in climate risk beliefs in the areas that experienced natural disasters versus not experienced. The number of county-year observations are also reported. The panel B reports the results of regressions of climate risk beliefs on the natural disasters indicators, including the disaster dummy and the amount of property damage caused by the disasters. The unit of observation is a county-year. We include county and year fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

Table 7
ESG score and natural disasters.

	1	2	3	4
	ESG Score	ENV Score	SOC Score	GOV Score
After Natural Disasters	2.8514***	2.8920***	4.2622***	1.3043***
	[9.129]	[7.090]	[10.649]	[5.978]
ROA	−0.8453	0.0178	−2.1272	−1.1770
	[−0.512]	[0.009]	[−0.845]	[−0.829]
Standard Deviation	−1.5389***	−1.9114***	−1.5305***	−0.6866***
	[−8.506]	[−7.985]	[−6.751]	[−5.499]
Market to Book	−0.0010	0.0045	−0.0108	−0.0033
	[−0.265]	[1.151]	[−1.464]	[−1.038]
RNDR	0.0652***	0.0627***	0.1160***	0.0202
	[5.480]	[4.620]	[4.617]	[1.421]
Log Asset	4.3039***	3.6233***	7.4593***	2.6942***
	[9.842]	[6.393]	[12.860]	[7.982]
Log Number of Analyst	0.5998***	0.6834***	0.5036**	0.5099***
	[3.971]	[3.494]	[2.426]	[3.887]
HHI Index	−1.3928***	−1.5935***	−1.7174***	−0.6233***
	[−14.840]	[−13.345]	[−14.190]	[−10.336]
Debt	2.2302***	2.8925***	2.2229***	0.7915**
	[7.031]	[6.935]	[5.171]	[2.475]
Cash Flow	−0.5606	−0.9792	−0.2582	0.0284
	[−1.133]	[−1.610]	[−0.348]	[0.065]
Industry Median ESG	0.7075***	0.4426***	1.5227***	0.4662***
	[7.171]	[3.642]	[11.497]	[8.216]
Observations	8957	8957	8957	8957
R-squared	0.856	0.843	0.806	0.700

This table reports the results of regressions of ESG scores, as well as its three components scores, on the after natural disaster dummy, which take the value of one if it is after firms experience a natural disasters, and zero otherwise. The unit of observation is a firm-year. All other variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and firm fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

Table 8
ESG score and natural disasters by sub-samples.

Panel A. ESG Score

	1	2	3	4	5	6
			ESG	Score		
	High Belief	Low Belief	All Sample	High Damage	Low damage	All Sample
After Natural Disasters	3.8242***	2.5244***	2.0537***	4.1356***	1.7837***	2.1655***
	[6.249]	[7.224]	[6.128]	[8.958]	[4.602]	[5.796]
After Natural Disasters * High Belief			2.3260***			
			[3.480]			
After Natural Disasters * High Damage						1.3433**
						[2.342]
ROA	−1.0135	−0.5511	−0.8281	1.1195	−2.2863	−0.8517
	[−0.423]	[−0.234]	[−0.498]	[0.402]	[−1.095]	[−0.518]
Standard Deviation	−1.6926***	−1.4628***	−1.5671***	−1.1990***	−1.7362***	−1.5315***
	[−6.434]	[−6.032]	[−8.670]	[−5.018]	[−6.868]	[−8.473]
Market to Book	−0.0012	0.1000	−0.0012	0.0012	−0.4255	−0.0011
	[−0.269]	[0.143]	[−0.297]	[0.300]	[−0.494]	[−0.292]
RNDR	0.0703***	−0.1989	0.0654***	0.0692	0.0772***	0.0650***
	[5.568]	[−0.630]	[5.462]	[0.957]	[6.666]	[5.480]
Log Asset	4.1781***	3.7805***	4.2395***	2.0287***	5.7891***	4.2947***
	[6.674]	[6.773]	[9.694]	[3.532]	[9.304]	[9.828]
Log Number of Analyst	0.6730***	0.5394**	0.6159***	1.0611***	0.3229	0.6004***
	[3.303]	[2.462]	[4.082]	[4.946]	[1.538]	[3.967]
HHI Index	−1.8112***	−1.0109***	−1.3861***	−1.2611***	−1.3896***	−1.3846***
	[−11.108]	[−9.688]	[−14.871]	[−9.848]	[−10.740]	[−14.692]
Debt	2.4467***	1.8718***	2.2563***	1.6046***	2.7265***	2.2329***
	[5.369]	[4.158]	[7.042]	[3.549]	[6.412]	[7.069]
Cash Flow	−0.6638	−0.3476	−0.5656	−1.1585	−0.3317	−0.5698
	[−0.980]	[−0.457]	[−1.132]	[−1.449]	[−0.531]	[−1.154]
Industry Median ESG	0.5680***	0.9109***	0.7199***	0.7031***	0.7536***	0.7203***
	[3.584]	[8.629]	[7.357]	[5.407]	[5.181]	[7.314]
Observations	4455	4502	8957	3709	5247	8957
R-squared	0.865	0.846	0.856	0.879	0.844	0.856

Panel B. ENV Score

	1	2	3	4	5	6
			ENV	Score		
	High Belief	Low Belief	All Sample	High Damage	Low Dageme	All Sample
After Natural Disasters	4.6085***	2.3274***	1.5489***	4.6183***	1.4534***	1.9510***
	[5.728]	[5.197]	[3.568]	[7.790]	[2.764]	[3.804]
After Natural Disasters * High Belief			3.9164***			
			[4.438]			
After Natural Disasters * High Damage						1.8432**
						[2.433]
ROA	−0.3405	0.3013	0.0160	0.6403	−0.6032	0.0031
	[−0.346]	[0.299]	[0.024]	[0.521]	[−0.739]	[0.005]
Standard Deviation	−98.3454***	−74.4473***	−84.4946***	−57.2744***	−99.8519***	−82.0068***
	[−6.465]	[−5.583]	[−8.198]	[−4.282]	[−6.908]	[−7.951]
Market to Book	0.0000	0.0011	0.0000	0.0000	−0.0001	0.0000
	[0.518]	[0.732]	[1.040]	[1.082]	[−0.049]	[1.102]
RNDR	0.0003***	−0.0014	0.0003***	0.0003	0.0004***	0.0003***
	[4.751]	[−1.051]	[4.597]	[0.926]	[5.341]	[4.611]
Log Asset	1.6366***	1.2509***	1.6272***	0.3277	2.5836***	1.6715***
	[4.383]	[3.673]	[6.207]	[0.952]	[6.890]	[6.373]
Log Number of Analyst	0.8426***	0.5790**	0.7274***	1.0275***	0.5390*	0.7004***
	[3.111]	[2.008]	[3.634]	[3.639]	[1.927]	[3.490]
HHI Index	−0.0032***	−0.0015***	−0.0022***	−0.0021***	−0.0022***	−0.0022***
	[−11.126]	[−7.718]	[−13.396]	[−8.991]	[−9.443]	[−13.207]
Debt	5.1593***	4.6809***	5.0227***	3.4842***	6.2180***	4.9539***
	[5.341]	[4.277]	[6.973]	[3.497]	[6.450]	[6.977]
Cash Flow	−1.6773	−1.0676	−1.4650	−2.3418	−1.1318	−1.4713
	[−1.382]	[−0.727]	[−1.602]	[−1.522]	[−1.013]	[−1.634]
Industry Median ESG	0.1538	0.3034***	0.2206***	0.2346***	0.2146**	0.2190***
	[1.627]	[4.931]	[3.852]	[2.981]	[2.554]	[3.790]
Observations	4455	4502	8957	3709	5247	8957
R-squared	0.851	0.837	0.844	0.868	0.829	0.843

This table reports the results of regressions of ESG scores in Panel A, and ENV scores in Panel B, on the after natural disaster dummy, which take the value of one if it is after firms experience natural disasters and zero otherwise. In Model 1 (2), the subsample of firms that have higher (lower) than median Belief is included. In Model 4 (5), the subsample of firms that experience above (below) median damage is included. In Models 3 and 6, we use the whole sample. The unit of observation is a firm-year. All other variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and firm fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

4.5. Local investor and ESG

So far, we focus on the connection between firms and local communities, on the basis that firm managers and employees live in the communities and thus are affected by local climate change beliefs. In this section, we explore a more direct connection between firms and local communities, namely whether firms have local institutional ownership. We identify firms' local ownership as the institutional investors which are within 100 miles of distance to the firms' headquarters. Dyck et al. (2019) show that institutional investors have great influences on the firm's ESG investments. When more institutional investors are from local, we expect the influences to be stronger and firms' ESG commitments would be affected more by local beliefs. We formally test Hypothesis 3 and present the results in Table 9.

First, we start with a subsample of firms that have or have zero local ownership and run the same regression models as in Table 3. From Models 1 and 2, we find that firms with local institutional ownership respond significantly to the level of the local climate change beliefs, while the correlation no longer exists for firms with no local ownership. When we include the interaction term between local ownership indicator with Belief in Model 3, the interaction term is highly significant and positive. In Models 4 to 6, we replace dependent variables with ENV scores and find consistent results. The results further confirm that local communities, including local investors, have strong effects on firms' decision-making on ESG commitments.

Table 9
ESG scores and local institutional ownership.

	(1)	(2)	(3)	(4)	(5)	(6)
		ESG Score			ENV Score	
	Local	No Local	All Sample	Local	No Local	All Sample
High Local Own * Belief			0.8054***			0.8580***
			[3.311]			[2.695]
Belief	0.6509***	−0.3263	−0.1402	0.6538***	−0.0556	−0.1214
	[4.849]	[−1.078]	[−0.598]	[3.655]	[−0.143]	[−0.397]
High Local Own			−0.2713			−0.4863
			[−1.162]			[−1.552]
ROA	−10.0755***	−15.4717***	−12.4414***	−11.3954***	−19.6917***	−14.6313***
	[−3.630]	[−3.611]	[−5.493]	[−3.222]	[−3.655]	[−5.131]
Standard Deviation	−0.6810**	−0.2862	−0.5883***	−0.6706**	−0.2900	−0.6286**
	[−2.539]	[−0.749]	[−2.639]	[−2.012]	[−0.622]	[−2.290]
Market to Book	−1.4090	−0.0205***	0.0043	−1.5328	−0.0127	0.0192***
	[−1.297]	[−2.654]	[0.715]	[−1.169]	[−1.260]	[2.795]
RNDR	0.0759***	−1.9168*	0.0438**	0.0109	−2.9570*	−0.0312
	[5.576]	[−1.796]	[1.975]	[0.419]	[−1.805]	[−0.798]
Log Asset	7.9965***	6.8650***	7.8501***	10.0895***	8.9768***	9.9787***
	[36.149]	[17.443]	[40.423]	[34.524]	[17.318]	[38.898]
Log Number of Analyst	0.5334***	1.3118***	0.6557***	0.4146**	1.2793***	0.5305***
	[3.511]	[5.546]	[5.110]	[2.120]	[4.295]	[3.235]
HHI Index	0.0414	−0.0012	0.0622	0.0149	−0.0047	0.0573
	[0.329]	[−0.006]	[0.559]	[0.090]	[−0.016]	[0.393]
Debt	−1.3314***	−3.8656***	−2.1407***	−1.5407***	−4.9199***	−2.6538***
	[−4.246]	[−6.873]	[−7.735]	[−3.665]	[−6.667]	[−7.197]
Cash Flow	0.3085	1.3406	0.4897	−0.3923	1.2113	−0.1730
	[0.409]	[0.957]	[0.731]	[−0.405]	[0.679]	[−0.203]
Industry Median ESG	0.9390***	0.6684**	0.9384***	1.0973***	0.9013**	1.1403***
	[5.794]	[2.351]	[6.560]	[5.234]	[2.520]	[6.186]
Observations	6887	2076	8963	6887	2076	8963
R-squared	0.494	0.494	0.478	0.450	0.466	0.434

This table reports the results of regressions of ESG or ENV scores on the climate change beliefs. In Model 1, the subsample of firms with the presence of local ownership is included. In Model 2, only firms that have no local ownership are included. In Model 3, we include the full sample and add the interaction term between local ownership dummy and Belief. We perform the same regression models in Models 4 to 6 but replace the dependent variable as ENV score. The unit of observation is a firm-year. All other variables are the same as defined in Table 1. All continuous, independent variables are normalized to mean of zero and a standard deviation of one. We include industry and time fixed effects throughout. The standard errors are clustered to account for heteroskedasticity. We report t-statistics in square brackets. ***, **, * represents statistical significance at the 1%, 5%, and 10% level respectively.

5. Conclusion

The impact of climate change on economic activities appears to be influenced by whether or not people believe in climate risk (Bakkensen & Barrage, 2021; Baldauf et al., 2020; Duan & Li, 2019; Li et al., 2020; Ratnadiwakara & Venugopal, 2020). We examine whether people's beliefs in climate risk affect firms' decisions to become more environmentally and socially responsible. We find that firms tend to have higher ESG scores in areas with higher numbers of climate change believers. The results are robust to different ways of measuring CSR activities, as well as different sample periods and measurements.

We further use the natural disaster events as a shock to within-firm change in climate risk beliefs and continue to find a positive and significant correlation between beliefs and ESG scores. The impact is stronger when the damage from natural disasters is more severe and when the disasters occur at high-belief areas. The results indicate that natural disasters and climate change beliefs reinforce one other, and that both factors contribute to firms' decisions to engage in CSR initiatives and become more environmentally and socially responsible.

Lastly, we examine the correlation between climate change beliefs and ESG scores with the presence of local institutional investors. Institutional investors are believed to play an important role in driving a firm's CSR performance (Dyck et al., 2019; Hwang et al., 2021; Krueger et al., 2020). Instead of focusing on the institutional investors as a whole, we focus on local institutional investors who share similar beliefs with firm managers. It is arguably easier for local investors to instill environment-related beliefs into the local management team. In fact, we find that the climate change beliefs only affect firms' ESG scores when the local investors are present. The relationship is no longer significant when firms have no local investors.

To our knowledge, this is the first study to connect climate change beliefs with firms' corporate social responsibility (CSR) efforts. We feel that there is a wide range of future research possible in this field, given that climate finance is a relatively new research topic that has begun to grow in recent years. Malik (2015) reviews a list of contemporary literature that examines the impact of CSR initiatives on corporate values and performance. Future research examining the effect of climate change beliefs on the relationship between CSR and firm values could be beneficial.

Declaration of Competing Interest

For our submission of "Do Climate Risk Beliefs Shape Corporate Social Responsibility?", we do not have any conflict of interest to declare.

Appendix A. Variable definitions

Variable Names	Variable Definitions
Climate Change Beliefs (Belief)	The percentage of people in a county who answer "Yes" to the survey question: "whether they believe that climate change is happening" from Yale Climate Opinion Maps 2014, 2016, and 2018
ESG Scores	Environmental, social, and governance (ESG) disclosure scores from Bloomberg Data Service (Bloomberg)
ENV Scores	Environmental disclosure scores from Bloomberg Data Service (Bloomberg)
SOC Scores	Social disclosure scores from Bloomberg Data Service (Bloomberg)
GOV Scores	Governance disclosure scores from Bloomberg Data Ser vice (Bloomberg)
ROA	Income before extraordinary items (IB) divided by total assets (AT)
Standard Deviation	Standard deviation of daily returns for each firm-year
Market to Book	Market value of common equity (PRCC_C * CSHO) divided by the book value of equity (CEQ)
RNDR	Research and development expense (XRD) divided by revenue (REVT)
Log Asset	Natural log of total asset (AT)
Log Number of Analyst	Natural logarithm of number of analyst followings the firms, from IBES
HHI Index	Herfindahl–Hirschman Index based on Fama-French 48 industries
Debt	Total debt (DLC + DLTT) divided by total assets (AT)
Cash Flow	Cash flows from operating activities (OANCF) divided by
Industry Median ESG	The median value of ESG scores by each Fama-French industry
Local Ownership	The sum of shares hold by local institutional investors divided by share outstanding

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