Impact of Climate Risk Disclosure on Insurance Industry

Preliminary Draft: Please do not share
This version: September 2023

Abstract

This paper explores the impact of climate risk disclosure on the insurance industry, focusing on California's regulatory context. Investigating a significant change in 2013 that lowered the mandatory disclosure threshold, the study compares disclosing vs. non-disclosing insurers' behavior when facing extreme weather events. Although the study refrains from rejecting the null hypothesis entirely, it uncovers potential reasons for limited influence. I test for reasons behind no impact, including insurers' risk management preparedness and investor responses. The results indicate that insurers tend to increase their premium by a more substantial proportion in the periods after weather-related incidents compared to periods with minimal or no such incidents. I also find results consistent with no significant investor reaction to extreme weather events with or without disclosure. The research contributes to the discourse on climate risk management in insurance, shedding light on the intricate dynamics between regulatory changes, firm behaviour, and disclosure practices.

Keywords: Insurance, Climate change, Risk disclosure

1 Introduction

Climate change has emerged as one of the most pressing global challenges affecting various aspects of society. For example, according to data from NCEI (National Centers for Environmental Information), between 2016 and 2020, the US experienced an average of 16.2 disasters per year that caused an economic loss of at least one billion, a substantial increase compared to 6.5 disasters per year between 1980 and 2019.[1] In light of the increasing climate risks, regulatory bodies and industry organizations are increasingly focusing on the need to disclose climate risks for businesses. In addition to offering vital insights into a company's risk landscape, these disclosures could have the power to impact the way a company operates. Consequently, it is essential to understand the consequences of these disclosures on firm behavior. The current study uses the mandatory Climate Risk Disclosure made by Property & Casualty (P&C) insurers to investigate whether climate risk disclosures impact insurers' behavior.

The significance of risk disclosure goes beyond mere transparency. By promptly furnishing pertinent and comprehensive information, such disclosure could give stakeholders a clear view of their business activities, risks, performance, and financial position. Public disclosure of risks, including climate change, is essential in achieving this objective.[2] Beyond elucidating existing vulnerabilities, climate risk disclosures extend to explaining a company's strategies for tackling these risks. This paves the way for identifying optimal practices to amplify post-disaster resilience. Moreover, investors' responses to disclosed climate risks could subsequently impact a company's behavior. Certain entities may not inherently prioritize climate risk, yet a mandatory disclosure regime can compel their attention toward the issue, instigating imperative mitigation measures. In March 2022, the SEC proposed rules to standardize and enhance climate-related disclosures for all public firms. The proposed rule will require all public companies to include climate-related disclosures in their registration statements and periodic reports. The proposal has received more than 11,000 comments.[3] The proposal proponents believe that disclosure would increase the investor's ability to evaluate the impact of climate

[1] https://www.ncei.noaa.gov/access/billions/

[2] International Association of Insurance Supervisors; https://www.iaisweb.org/icp-online-tool/13531-icp-20-public-disclosure/

[3] https://www.sec.gov/comments/s7-10-22/s71022.htm

risk on firms and make informational decisions. On the other hand, opponents argue that disclosures will put an extensive cost burden on the disclosing firms.

The P&C insurance industry presents a conducive environment for investigating climate risk disclosure policies for several reasons. First, insurance companies are inherently engaged in risk assessment and management, aligning closely with the core principles of climate risk disclosure. P&C insurers are significantly affected by climate-related events since insurers bear the financial brunt of damage resulting from extreme weather events. Second, the mandatory nature of certain climate risk disclosure requirements, such as the NAIC (National Association of Insurance Commissioners) Climate Risk Disclosure Survey, offers a controlled setting to assess the effects of regulatory-driven disclosures on insurer behavior. Thirdly, insurers' financial metrics and decision-making processes are transparent and regulated, providing a robust basis for evaluating how climate risk disclosure influences their behavior and accounting practices.

Climate risk disclosure can affect insurer behavior and accounting policies due to its potential to alter perceptions, strategies, and stakeholder interactions. Transparent disclosure of climate risk could force insurers to confront the impact of climate change on their operations. By clearly articulating their exposure to climate-related risks, insurers can better assess potential financial implications and subsequently adjust their risk management strategies. For instance, a Property and Casualty (P&C) insurer operating in a coastal region may be prompted to revise its underwriting criteria and pricing models in response to increased flood risks. In addition, the comprehensive disclosure of climate risk can affect insurers' financial reporting and reserve provisioning. Incorporating potential liabilities arising from climate change-related events into reserve calculations can lead to more accurate and robust reserve provisioning, preventing future financial instability due to unexpected claims.

However, climate risk disclosure might not uniformly impact insurers' behavior due to factors such as already well-established risk management practices, industry-wide awareness of climate risks, and the long-term nature of climate-related impacts. Insurers with robust risk management strategies might find that disclosure reaffirms existing practices rather than triggering significant changes. Additionally, in industries (like insurance) accustomed to frequent weather-related risks, disclosure could serve as an incremental data point rather than a cata-

lyst for behavior changes. Furthermore, the gradual unfolding of climate risks over extended periods could lead to incremental adjustments rather than immediate changes. Finally, some insurers might focus on compliance rather than embracing a proactive approach, potentially limiting the transformative impact of climate risk disclosure on their behavior.

In 2010, the NAIC launched the Insurer Climate Risk Disclosure Survey as a reporting mechanism for insurers. The survey's central objective is to furnish regulators with insights into how insurers evaluate and address risks associated with climate change. The survey encompasses eight questions covering topics of climate risk governance, climate risk management, modeling and analytics, stakeholder engagement, and greenhouse gas management. While the NAIC does not mandate its members' participation, specific state regulatory authorities require insurers to write direct premiums beyond certain thresholds to participate in the survey. California was the first state to require insurers operating in the state and earning above $500 million in direct premiums at the time of inception. Subsequently, this initiative has gained traction, and by 2021, fifteen states had enacted mandates requiring insurers with direct premiums exceeding $100 million to participate. In 2021, over 1400 insurers engaged in the survey, collectively encompassing nearly 80% of the entire US insurance market based on premiums.

California's pioneering move to enforce mandatory climate risk disclosure through the NAIC survey offers a unique opportunity to investigate the impact of such disclosure on P&C insurers. The alteration in the threshold level for obligatory climate risk disclosure in California serves as an exogenous shock that influences the disclosure landscape for insurers. Specifically, in 2013, the state resolved to reduce the direct written premium (DWP) threshold for insurers to disclose climate risks, shifting it from $300 million to $100 million. I study and categorize insurers with Direct Written Premium (DPW) between $0 to $300 million into two groups. The first group encompasses insurance companies directly impacted by the new regulation in 2013—those with a DPW between $100 million and $300 million. The second group, designated as the control group, comprises companies with a DPW below $100 million, exempt from disclosure due to falling below the prescribed threshold. Given that insurance companies are subject to state-level regulations, narrowing the focus to firms operating within California serves to control the regulatory landscape. Moreover, I account for all firm-specific factors, en-

compassing size, profitability, and diversification, to eliminate alternative confounding factors from the analysis.

I conduct a comparative analysis of the effects of extreme weather events on insurers' accounting practices, specifically reserve deficiencies, as well as their tangible actions, encompassing reinsurance policies and exposure to high-risk states like California. The analysis examines the change in the behavior of treatment groups before and after the treatment and contrasts it with the control group. Climate risk disclosure, being a potential catalyst, can exert influence on insurers' reserve provisioning by inciting adjustments to account for plausible forthcoming liabilities stemming from climate-related incidents. Moreover, this disclosure might trigger a reevaluation of insurers' reinsurance strategies, potentially motivating them to seek heightened coverage against climate-induced risks. Moreover, insights into insurers' exposure to climate-vulnerable states, such as those prone to climatic uncertainties like California, could conceivably impel insurers to re-calibrate their underwriting practices and pricing frameworks, thereby fostering enhanced resilience.

Despite these theoretical propositions, the study is unable to reject the null hypothesis, suggesting that climate risk disclosure does not wield a discernible impact on insurers' behavioral patterns. While the theoretical potential for such influence exists, the empirical analysis does not substantiate its tangible manifestation. Next, I attempt to probe the plausible factors contributing to the absence of impact. First, insurance companies specialize in risk management. This inherent expertise renders them adept at addressing the ramifications of climatic occurrences, regardless of the presence of disclosures. A key mechanism for insurers to recuperate losses lies in the prospect of heightened premiums in subsequent periods. The elevation in premiums can be fueled by insurers raising their pricing structures, thereby driving demand-side dynamics. Alternatively, extreme weather events might foster an augmented demand for insurance among consumers aiming to safeguard their interests.

Another avenue for investigating the impact of disclosure on corporate conduct pivots on the reactions it triggers. A noteworthy recipient of this disclosed information comprises shareholders. However, if shareholders' responses to such disclosures fail to exert substantial influence, the impetus for instigating alterations in the firm's behavior becomes diluted. Thus,

the influence of disclosure becomes contingent upon its capacity to resonate with stakeholders in a manner that steers significant adjustments. Therefore, I delve into a comprehensive exploration of the rationales underlying the paper's inability to reject the null hypothesis, aiming to unravel their intricacies and implications.

First, I investigate whether insurers incur abnormal losses attributable to extreme weather events and whether subsequent strategies are employed to recuperate these losses post-crisis. On testing the impact of extreme weather events on insurance companies, I find that adverse weather events can result in abnormal losses for insurance companies. However, I also find some evidence that insurers tend to increase their premium by a more substantial proportion in the periods subsequent to weather-related incidents compared to periods with minimal or no such incidents. In a larger context, this indicates that insurers could partially recover their losses in period t by implementing premium adjustments in period $t + 1$. Further, some evidence indicates that companies tend to raise their reinsurance levels in response to increased frequency of weather events. In summary, the results offer insight into the connection between weather events and increased losses, hinting at insurers' responses involving premium and reinsurance level adjustments.

Subsequently, I dive into the second explanation of the lack of impact of disclosure on insurers. I begin by examining how investors react to extreme weather events by looking at the 7-day CAR (Cumulative Abnormal Return) from the Fama French three-factor model surrounding the event. According to the Efficient Market Hypothesis, if shareholders perceive that weather events pose a risk to insurance companies, then there should be abnormal market reaction. However, the results reveal a lack of evidence supporting abnormal market reactions to weather events. In addition, the 7-day CAR comparison does not reveal any discernible divergence in investor responses between firms that disclose climate risk and those that do not. This could be attributed to investors not viewing climate risk as a substantial threat to insurers, leading to muted reactions. Another explanation could be investors acknowledging insurers' ability to make up losses caused by weather events by increasing premiums ex post. An alternative explanation for this lack of response may be investor inattention. Given that survey disclosures are not integrated within financial statements and remain absent from insurers'

websites, it is plausible that investors do not consult them when making decisions. At this stage of analysis, the exact cause of the absence of an investor reaction remains elusive. Further exploration is necessary to determine the underlying factors that contribute to this lack of response.

This study offers a multifaceted contribution to the existing literature. First, it extends the discourse on risk disclosure effects by investigating the potential influence of climate risk disclosure on insurers. While prior research has demonstrated the impact of risk disclosures on firm behavior, such as reduced information asymmetry following macro shocks (Hail et al., 2021) and increased pro-environmental activities (Kim et al., 2022), the present study examines whether climate risk disclosure affects insurers' integration of climate change models into reserve provisioning. Second, the research adds to the realm of real effects that arise from disclosures. I examine whether disclosure practices impact tangible business decisions such as reinsurance policies and exposure to disaster-prone regions. Moreover, in the context of the SEC's proposed climate-related disclosure rules, the study holds significance. By probing whether such disclosures benefit insurance industries it contributes to the ongoing debate surrounding the potential benefits and costs of standardized climate-related disclosures. Furthermore, the study diverges from the ESG focus of previous work and instead links climate risk disclosure with firm risk assessment and mitigation policy, offering fresh insights. Lastly, in a domain where the findings have been inconsistent, the study contributes by investigating the impact of extreme weather events on insurance companies, adding nuance to the understanding of investor reactions to these events.

However, when examining the impact of climate risk disclosure on P&C insurers, it is crucial to recognize that the findings may not be universally applicable to all industries. The insurance sector has inherent characteristics that make risk mitigation an integral part of core operations. Insurance companies have a vested interest in assessing, pricing, and managing risks, making them particularly sensitive to the impact of climate change. Thus, the degree of influence that climate risk disclosure has on insurers may differ from that of other industries where risk management is not ingrained.

The remainder of this paper is organized as follows. Section 2 examines institutional partic-

ulars. Section 3 discusses the related literature and hypothesis development. Section 4 delves into the data specifications and methodology. Section 5 elucidates the main results of discontinuity design. In Section 6, I explore the impact of weather events on P & C insurers' financial status. In Section 7, alternative explanations of non-results, that is, investors' responses to climate risk disclosures, are explored. Finally, Section 8 provides concluding remarks.

2 Institutional set-up

2.1 Insurance Industry and Climate Risk

Extreme weather events are becoming more frequent and intense, raising concerns about their potential impact on various sectors. According to a report released by the American Property Casualty Insurance Association,[4] 2022 was the eighth consecutive year that the United States experienced at least 10 disasters, causing more than a billion dollars in damage. Insurance companies bear huge losses and risks from natural disasters and climate change. As of August 2023, the global insurance industry had racked up $50 billion in losses from natural catastrophes by 2023. It has been the worst start to a year since 2011, highlighting the challenges the sector faces from climate change.[5] According to a report by the Insurance Information Institute [6], wind, hail, fire, and lightning were responsible for 64% of the losses suffered by homeowners' insurance markets.

Climate-related risks to insurance companies can be divided into five major categories: physical risk, transition risk, liability risk, operational risk, and reputational risk. P&C insurance companies are exposed to these climate-related risk on two fronts: (i) on the asset side through investments in firms contributing to climate change[7] and (ii) on the liability side through property and casualty underwriting. A detailed description of these risks and their examples is listed in the appendix B.

[4] https://www.apci.org/media/news-releases/release/75202/

[5] https://www.ft.com/content/7ad831a7-801d-47e7-9158-4e832b798bb0

[6] https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance

[7] Carbon extensive industries could experince reduction in valuation with increased popularity of ESG investing. If insurance companies have these comapnies in their investment portfiolio, they could suffer investment losses.

Multiple strategies are available for insurers to mitigate or reduce the impact of climate change. Reinsurance is the most common mechanism through which insurers can shift a portion of their risk to third-party reinsurers. However, recently, the cost of reinsurance has been increasing. As per half-year results of Hiscox (an FTSE 100 insurer), reinsurance prices for natural catastrophe has risen by 43% in North America. [8] Additionally, some states, such as California, do not allow insurance companies to pass on reinsurance costs to consumers. Another way to recover losses is to increase the premium charged for the next period. However, insurers require the approval of state regulators when the premium rate changes. In areas such as homeowner insurance, the approval process can take months and may not even be approved to the full extent of the request (Oh et al., 2002).

Insurance companies can also exit a certain product or geographical market if they find it unprofitable. For example, State Farm and All State Insurance have exited the California home insurance market due to increased wildfire risk. Finally, insurance companies have started to encourage adaptation measures. Insurers are trying to incentivize customers to adopt measures that reduce the probability and amount of claims in the event of weather events. For example, offering a discount on premiums to homeowners to make their houses more resistant to weather events.

US state regulators seem to be concerned about the insurers' preparedness to handle increasing weather events. In a survey conducted by Deloitte in 2019, the majority of respondents (regulators) answered that they are either unaware of insurers' preparedness to deal with this threat or are not fully confident that insurers are indeed prepared.[9] Regulators are also worried about rising insurance premiums and reduced or even total withdrawal of coverage in certain areas. More information through effective disclosure could help regulators in assessing the effectiveness of insurer actions to mitigate climate-related risks.

[8] https://www.ft.com/content/7ad831a7-801d-47e7-9158-4e832b798bb0

[9] Deloitte floated the online survey amongst the 56 member jurisdictions of the NAIC. They received a total of 27 responses representing 19 member jurisdictions of the NAIC. The detailed report can be found here: https://www2.deloitte.com/us/en/pages/financial-services/articles/insurance-companies-climate-change-risk.html

2.2 Climate Risk Disclosure

In the US, State insurance regulators are the primary supervisors of the P&C insurers, overseeing areas such as market conduct, solvency, and consumer protection. At the federal level, the Federal Insurance Office (FIO) monitors the insurance industry, offering insights to policymakers and coordinating with state regulators to ensure national consistency and effective consumer protection. Additionally, NAIC, a key industry organization, facilitates collaboration among state regulators, setting standards, sharing information, and developing model regulations. The Insurer Climate Risk Disclosure Survey was launched in 2010 by NAIC as a voluntary risk management tool that helped state regulators collect information from insurers. The main purpose of the survey is to bring transparency to insurers' climate risk opportunities and management practices. The original survey contained eight questions asking insurers to describe how they incorporate climate risks into their "mitigation, risk management, and investment plans."

California was the first state to make the survey mandatory for all insurers in the state who wrote more than $500 million in direct written premiums (DWP). In the next few years, more states have made the survey mandatory and reduced the threshold for mandatory disclosure. Appendix C describes the staggered adoption of the survey. For the year 2010, California was the only state with mandatory disclosure at the $500 million direct-premium threshold level. In 2011, New York and the state of Washington joined California, and the three states lowered the threshold for mandatory filing to $300 million DWP. The threshold was again lowered to $100 million in 2013, and three new states adopted the survey (Connecticut, Minnesota, and New Mexico). Currently, the survey is mandatory in 15 states.

The original survey consisted of nine qualitative questions, as listed in the appendix D. The questions cover climate risk-related topics, including emissions mitigation, climate risk management policy, engagement with policyholders and constituencies, and the impact of climate risk on investments. The Survey is publicly available on the NAIC Climate Risk Disclosure Survey website maintained by the California Department of Insurance. As of 2020, around 228 group/unaffiliated insures have filled out the survey.

In 2021, the NAIC changed its survey format to align it with the International Task Force

on Climate-Related Financial Disclosures (TCFD). The new TCFD-based survey was based on four thematic areas: governance, strategy, risk management, metrics, and targets. There are four open-ended questions that insurers must answer (Appendix F). Apart from the four open-ended questions, there were voluntary closed-ended questions.

3 Related literature and hypothesis development

Real economic consequences of corporate disclosures have been an important topic of discussion ((Kanodia and Sapra, 2016); (Leuz and Wysocki, 2016) ; (Roychowdhury et al., 2019)). Accounting disclosures primarily act as a channel through which information flows from within a firm to outsiders. They can also act as a reverse channel depending on the reception of the information by the receiver. Therefore, I argue that climate risk-related disclosures could induce changes in real and accounting behaviors within the firm. I specifically examine the P&C insurers to determine whether disclosure of climate risk could bring about changes in how insurers incorporate extreme weather-related information in their reserve provisioning. Additionally, I test whether firms disclosing climate risks have different behavior compared to non-disclosing firms, in terms of reinsurance policy and exposure to calamity-prone states like California.

The insurance sector has inherent characteristics that make risk mitigation an integral part of core operations. Consequently, the incorporation of climate risk considerations should logically be intrinsic to insurance companies, irrespective of disclosure requirements. Nonetheless, several factors could impede this internalization process. Climate change impacts tend to unfold across protracted time-frames, whereas P&C insurance contracts typically operate within shorter temporal scopes. Thus, insurers might overlook the influence of climate risk on their shorter-term business models, potentially assuming that these risks predominantly materialize over the long run. Furthermore, transitioning to more climate-resilient practices might entail upfront costs that could impact short-term financial performance. Quarterly financial reporting and pressure from shareholders for short-term profits might deter insurers from making long-term investments in climate adaptation.

If public disclosure of climate risk increases public awareness about how insurers assess and mitigate climate risk, disclosure could have real effects on manager actions. If managers have to disclose their strategy for assessment of climate risk, the cost of non-assessment increases. For example, Q8 of the survey specifically asks if insurers use any type of computer modeling to manage climate risk. In order to answer yes to this specific question, the insurer must indeed employ a modeling system that incorporates climate risk as an input. Therefore, disclosing firms' managers might end up improving the climate risk assessment system. These improved assessment systems could manifest an improved estimation of claims that firms could expect post-extreme weather events. The reserve provisioning of incurred losses is based on various components: actual claims filled, expectation of payout for claims filed, and expectation about claims that will be filled in the future related to the current year's weather event. Integrating potential liabilities stemming from climate change-related incidents into reserve calculations can enhance the accuracy and robustness of reserve provisioning, thus averting potential financial instability caused by unexpected claims.

Additionally, the survey has questions asking about other general mitigation strategies of the insurers. It could expose a firm to heightened costs of not doing anything to mitigate the risk. The transparency achieved through climate risk disclosure might compel insurers to directly confront the ramifications of climate change on their operational landscape. By clearly communicating their exposure to climate-linked risks, insurers can make more informed evaluations of potential financial consequences, subsequently adapting their risk management approaches. Therefore, disclosures could incentivize managers to increase risk-mitigating activities like reducing exposure to states that are more prone to disasters. It could also impact insurers' policies in terms of how much risk they want to keep on their books and how much they want to reinsure with a third party. Therefore, I state my main hypothesis in the null form:

H1. Mandatory Climate Risk disclosures do not influence P&C Insurers' behaviour.

The current paper adds to the risk disclosure literature. Risk disclosures have been found to have an impact on firm behavior. Firms with more transparent disclosure of foreign exchange risk appear to exhibit a lower information asymmetry after macro shock (Hail et al.,

2021). Firms voluntarily disclosing climate risks also tend to engage in more pro-environmental activities (Kim et al., 2022). The disclosure of climate risk appears to influence insurer investment decisions (Ivantsova et al., 2021). The market reaction to the disclosure of risk factors has declined significantly after the 2008 crisis (Beatty et al., 2019). However, specific risk Factor disclosures are positively associated with positive market reaction (Hope et al., 2016). The current paper examines whether climate risk disclosure could impact insurers' ability to incorporate climate change modeling in their reserve provisioning effectively.

Second, the current paper also adds to the real effects of disclosure literature. According to this strand of literature, financial reporting could impact real behavior by acting as a reverse channel depending on the reception of the information by the receiver. Firms in California were found to increase supplier due diligence after state regulation requiring them to disclose how they address suppliers' human rights violations (She, 2022). Mandatory disclosure of mine-safety records in financial reports seems to improve worker safety but reduces productivity (Christensen et al., 2017). The current paper is trying to find whether disclosure could impact how insurers mitigate climate risk, like reinsurance policy and exposure to disaster-prone regions. Firms' approach to risk mitigation, including those related to climate change, is important because they can directly impact its financial stability, operational continuity, and overall resilience in the face of challenges. Understanding the impact of disclosure on risk mitigation strategies taken by insurers could help in promoting sustainable practices.

Third, in March 2022, the SEC proposed rules to standardize and enhance climate-related disclosures for all public firms. The proposed rule will require all public companies to include climate-related disclosures in their registration statements and periodic reports. The proposal has received more than 11,000 comments.[10] The proposal proponents believe that disclosure would increase the investor's ability to evaluate the impact of climate risk on firms and make informational decisions. On the other hand, opponents argue that disclosures will put an extensive cost burden on the disclosing firms. The purposes of the SEC mandate differ from the NAIC's. SEC's proposal aims to provide investors with the material information they need to make educated investment choices. Conversely, the NAIC's survey is designed with

[10]https://www.sec.gov/comments/s7-10-22/s71022.htm

the specific aim of furnishing regulators with information that empowers them to oversee the insurance market more effectively. The SEC's proposed rule changes would affect, among other firms, over 110 public US insurance companies, representing over 55 percent of the US P&C insurance market in terms of direct premiums written (DPW). 66 of these public companies already participate in the NAIC Climate Risk Disclosure Survey.[11] While disparities exist in the content and objectives of these disclosure frameworks, investigating the effects of the NAIC's disclosure mandate could yield valuable insights into how insurers might react to compulsory climate risk disclosure.

Fourth, it provides insight into the impact of climate risk disclosure. The existing literature has primarily focused on the impact of the disclosure of carbon emissions. Matsumura et al. (2014) and Griffin et al. (2017) finds evidence suggesting that firms disclosing higher levels of carbon emissions are valued lower by the investor. Tomar (2023) found that firms reduce GHG emissions following mandatory disclosure of emission data. Kim et al. (2022) finds that firms that voluntarily disclose climate risk in their 10-K reports tend to reduce anti-environmental activities. Unlike these previous studies, the current paper does not focus on a firm's ESG behavior. Instead, the paper's aim is to tie climate risk disclosure with other firm outcomes: incorporating climate risk into reserve provisioning and risk mitigation strategy.

Lastly, the paper adds to the literature on the impact of weather events on insurance companies. Previous literature has found contradictory evidence on investors' responses to extreme weather events. Schuh and Jaeckle (2022) finds that insurance stocks earn negative abnormal returns in response to hurricanes with an adjusted cost of more than 10 billion dollars. Similarly, Lamb (1995) finds a negative stock market reaction to Hurricane Andrew. However, Hagendorff et al. (2015) finds that for 19 mega catastrophic disasters between 1996-2010, the stock market reaction was negative, but the magnitude was low. Shelor et al. (1992) finds that P&C insurers' stock experienced appreciation in value after the 1989 California Earthquake. Therefore, the impact of extreme weather events on investor response is unclear.

[11] Treasury's Federal Insurance Office Releases Report Assessing Climate-Related Risk, Gaps in Insurance Supervision. https://home.treasury.gov/news/press-releases/jy1579

4 Research Design

4.1 Sample Selection

In this study, I focus on insurers operating in California. Insurers are regulated at the state level. Therefore, studying only one state at a time would ensure a consistent regulatory environment. I selected California as it was the first state to implement a mandatory survey. In 2013, California reduced the mandatory disclosure cutoff point to $100 million in DWP from $300 million. The change in the threshold provides an exogenous shock to the insurance firm's disclosure environment. I define my treatment group as insurers affected by the 2013 regulation change, that is, insurers with DPW between $100 million -$300 million. The Control sample consists of insurers that earn a DPW of less than $100 million, as they are not obligated to fill out the survey. Every year, new firms are treated. However, after 2014, firms near the cutoff could anticipate treatment and change their behavior beforehand. Figure 4 plots the proportion of insurers responding to the survey at the threshold in 2013. The plot indicates that there is an upward tick in insurers' propensity to fill the survey at the threshold. I also test for continuity at the threshold to ensure that insurers do not manipulate their DPW to avoid disclosures. Figure 5 presents the continuity plot indicating no manipulation at the threshold.

The sample period is 2009-2017. I started in 2009, the first year when the survey was introduced. Therefore, it controls for any changes in the industry due to the introduction of the survey. In addition, because I need reserve data as of $t + 5$, I have to end my analysis in 2017. I also require sample firms to have financial performance data. The final sample comprises 3,938 firm-year observations from 557 unique P&C insurers.

4.2 Data

I combine and use data from three sources : (i) extreme weather events, (ii) financial statements of insurers, and (iii) responses of insurers to the climate risk disclosure survey.

4.2.1 Weather events Data

The data on extreme weather events is compiled from NCEI (National Centers for Environmental Information). NCEI maintains a record of all natural events in which the damage cost exceeds $1 billion (CPI adjusted to 2023). NCEI tries to estimate the economic loss incurred due to natural events using various public and private sector sources.[12] NCEI maintains the list of billion-dollar disasters from 1980-2023 (as of August 2023). During this period, there have been 363 confirmed billion-dollar weather/climate disaster events in the United States. It included 30 droughts, 41 floods, 9 freeze events, 180 severe storms, 60 tropical cyclones, 21 wildfires, and 22 winter storms. Collectively, these events led to 15,971 deaths and substantial economic losses in the affected regions.

The database includes detailed information on the states affected by the disaster and the start and end date of the disaster. I exclude droughts from my analysis since the time period of droughts was 12 months, i.e. it was reported at an annual level with no specific date. Therefore there is no varaition in the data. Figure 1 summarizes the number of extreme weather events by year for the period 2000-2022, along with the total economic loss. The number of billion-dollar disasters has increased from 5 per year in the year 2000 to 20 per year in the year 2020. The pattern hints either at a greater economic impact of weather events or an increase in underlying climatic conditions that produce these events today than they did twenty years ago.

Nonetheless, there is a limitation in the NCEI dataset—it exclusively includes billion-dollar disasters, which are the events that insurance companies are most likely to be concerned about and have policies in place to address. Smaller and medium-sized weather events, on the other hand, are often overlooked in risk analysis and might gain significance for firms that are obligated to disclose climate risks. Additionally, the data set ignores the effect of the growing US economy, and disasters that are below $1 billion might still be of importance in prior years. [13]

[12] Detailed methodology can be found at https://www.ncei.noaa.gov/access/billions/

[13] https://rogerpielkejr.substack.com/p/billion-dollar-disasters-are-a-national?utm_source=substack&utm_medium=email

4.2.2 Financial statements

P&C insurers must report state-by-state underwriting data for each business line. I used the Standard & Poor's Market Intelligence (henceforth referred to as SNL) database to retrieve the data. Firm-level data is available at a quarterly level. However, state-wise data are available only at an annual frequency. Insurers also report detailed financial statements as part of their regulatory filings, including regulatory capital positions and reserve deficiencies, at the insurer×year level.

Insurance firms have to adhere to statutory accounting principals (SAP) when reporting to state regulators. Under SAP, the loss reserve represents the estimated financial obligation of the insurance company for claims related to all losses that occurred before the balance sheet date. Loss reserves constitute the most substantial liability item on insurers' financial statements ((Petroni, 1992); (Gaver and Paterson, 2004)). Estimating claim loss expenses can be subjective since not all claims stemming from current period losses are submitted by the balance sheet date. Furthermore, even when claims are made within the current period, the final cash settlement frequently faces delays spanning several years. An exceptional characteristic of the loss reserve is that insurers are required to furnish detailed information regarding the gradual resolution of claims over an extended duration.

Insurance companies must file a Schedule P that provides an analysis of the total loss incurred. The loss incurred is also available separately for each business line. Part 2 of Schedule P provides information on incurred net losses and defense & cost containment expenses reported at the year-end. It shows the losses incurred over the past 10 years and how the estimation of these incurred losses has developed over the past 10 years. Consistent with previous literature, I use a 5-year development period to determine reserve deficiency ((Gaver and Paterson, 2004); (Grace and Leverty, 2012); (Petroni, 1992)). For each insurer year, I subtract the original loss reserve recognized in year t from the developed reserve in year $t+5$. To control for variation in insurer size, I use two deflators: (i) Original Loss reserve and (ii) Net Premium earned (NPE_t). A detailed example is provided in Appendix G.

4.2.3 Climate Risk Disclosure Survey

Survey responses are collected from a publicly available database maintained by the California Department of Insurance (CDI). The survey responses are used to identify which insurers have filed the Survey. Appendix E provides sample responses of two big insurance players. Starting in 2012, insurer responses are coded as 'Yes' or 'No' to each of these questions. Figure 2 presents the trend in responses to the nine questions. Coded responses are available from 2012 to 2020 for all questions except Q4, where data for two years (2013 and 2016) is missing on the NAIC portal. On average, every question received Yes from 80% of respondents. The only exception is Q5b, which has only a 50% Yes rate. Q5b relates to whether insurers have made any change to their investment policy in response to climate change. It seems that insurers have considered the impact of climate change on their investments but have not altered their investment strategies.

4.3 Model Set-up

I examine whether climate risk disclosure influences P&C insurance firms' behavior by estimating the following equation:

$$Firm_Financials_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t \times Disaster_t + \Sigma \gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + \epsilon \tag{1}$$

In equation 1, the dependent variable $Firm_Financials$ is either a measure of the reserve deficit, the percentage of DPW reinsured, or a measure of the insurer's exposure to California for firm i in year t. $Treat$ is an indicator variable that equals one if the insurer's DPW is between \$100 and \$300 million and zero if the insurer's DPW is less than \$100 million. $Post$ is an indicator variable that equals one if the year is greater than or equal to 2013. Disaster is one of three variables capturing the impact of weather events on insurers: the number of weather events experienced by insurers, the magnitude of weather events (in terms of economic loss caused by them), or the percentage of DPW exposed to these weather events.

As discussed in Section 4.2.2, I compute reserve deficiency by subtracting the original loss

reserve recognized in year t from the developed reserve in year $t + 5$. To control for variation in insurer size, I use two deflators: (i) Original Loss reserve and (ii) Net Premium earned (NPE_t). Recognizing the non-uniform risk exposure across different lines of business, I also focus on reserve deficiency exclusively within the homeowners' line of business since residential properties are vulnerable to weather events. These events, such as hurricanes, tornadoes, floods, wildfires, and severe storms, can lead to structural damage, roof leaks, flooding, and destruction of personal belongings.

The second dependent variable that I examine is the percentage of DPW reinsured by the insurers. Risk disclosures could motivate insurers to incorporate weather events into their reinsurance policy. Increased transparency on climate-related risks would enable reinsurance companies to more accurately price policies, allocate resources for risk management, and develop strategies to mitigate climate-related impacts, ultimately enhancing the industry's ability to provide effective coverage in the face of evolving climate challenges. Additionally, I look at measures that gauge insurers' exposure to California. Specifically, I assess two variables: first, the percentage of direct premium written in California relative to the total premium written; second, the loss ratio within California, computed as the ratio of incurred losses to DPW. Understanding insurers' susceptibility to climatic uncertainties in states like California could prompt them to adjust their underwriting strategies and pricing approaches, ultimately enhancing their resilience against climate-related risks.

To ensure a comprehensive analysis, various firm-specific factors are considered, including size, profitability, and diversification. Factoring in firm size prevents any undue influence from operational differences, recognizing that larger insurers might have distinct capabilities and risk exposures. Profitability control aids in isolating the impact of climate risk disclosure, accounting for potential independent effects of firms' financial performance on behavior. Diversification controls add depth by exploring how climate risk disclosure affects behavior differently across diverse business portfolios. Continuous variables are winsorised at the 1% level to manage extreme values. Additionally, firm-fixed effects account for unchanging firm-level traits, while year-fixed effects accommodate time-varying fluctuations.

Table 1 presents a comparison of the treatment and control group. In Panel A, during the

pre-period, companies in the treatment group exhibit larger size, greater diversification, and higher profitability. However, treatment firms are observed to be less profitable within California compared to the control group. Panel B presents the comparison in the post-period. In the post-period, the underlying distinctions persist in a manner akin to the pre-period. However, the treatment group's total reserve deficiency is lower than that of the control group in the post-period. Furthermore, the previously observed disparity in profitability within California between the two groups is no longer statistically significant. This suggests that climate risk disclosure could be associated with a mitigated reserve deficiency and a convergence in profitability between the groups within California.

5 Main Results

Panel A of Table 2 reports regression summary statistics from estimating equation 1. The coefficients on $Treat \times Post \times Disclosure$ are positive but insignificant for all measures of total reserve deficiency in columns 7-12. I also look at reserve deficiency specific to homeowners' line of business, as residential properties are most likely to be affected by weather events. The coefficient on $Treat \times Post \times Disclosure$ is significant at the 10% significance level when disaster measure is the insurer's exposure to disaster. It indicates that disclosing firms' reserve deficiency for homeowners' line of business increases in post-period in response to weather events. However, the coefficients are negative but insignificant for the remaining two measures of disaster. Overall, The tests fails to to reject the null that reserve deficiency remains unchanged for firms disclosing climate risk.

Panel B of Table 2 reports regression summary statistics from estimating equation 1. The coefficient is significantly positive at a 10% significance level when disaster measure is the insurer's exposure to disaster. It indicates that disclosing firms reinsure a higher proportion of their DPW in post-period in response to weather events. However, the coefficients are insignificant for the remaining two measures of disaster. Overall, The tests fails to to reject the null that the reinsurance policy remains the same post-disclosure for treatment firms.

Panel C of Table 2 reports regression summary statistics from estimating equation 1. The

coefficients on $Treat \times Post \times Disclosure$ are insignificant for all measures of total reserve deficiency. Therefore, The tests fails to to reject the null that disclosing firms do not change their business exposure to California or do not have a different loss profile in California than non-disclosing firms.

The tests fails to to reject the null that climate risk disclosure does not have any impact on the insurer's behavior. Therefore, I try to underline the potential reasons behind why disclosures might not have any impact. Foremost, Insurance companies are in the business of risk management. Therefore, with or without disclosure they are already equipped to deal with the the impact of weather events. Insurance companies could offset the losses by increasing their premium in future periods, going for reinsurance, or exiting high-risk markets.

Another channel through which disclosure impacts firm behavior is based on how the disclosure reacts to it. One of the major receivers of information is shareholders. If shareholders do not react to these disclosures, it might not induce any change in the firm's behavior. Additionally, survey disclosures are not part of financial statements, nor are they available on insurers' websites. Therefore, it may not beeasily avavilable for investors for reference when making decisions. Next, I try to look deeper into some of these explanations for the tests' failure to reject the null.

6 Insurers' Response to Weather Events

The effects of extreme weather events are contingent upon how insurers react to them. Insurers could incorporate data from their experience to accurately match rate to risk, and increase their premium in the next periods. Furthermore, the demand for insurance could also increase in risky areas. Consumers are more likely to opt for insurance after experiencing any loss due to weather events. Therefore, insurers might be able to offset current-period losses by increasing premiums earned in the next period. However, insurers need prior regulatory approval to increase rates and might not be able to get it readily, constraining their ability to increase the rate.

Firstly, I examine the impact of weather events on the current period's losses. I use the

following equation to estimate how weather events impact current period losses:

$$Change_Loss_{i,t} = \beta_0 + \beta_1 Disaster_t + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon \quad (2)$$

In equation 2, the dependent variable $Change_Loss$ is the percentage change in loss incurred in quarter t compared to quarter $t-4$ for firm i. I compare the same quarters across years to account for seasonality. the main variable of interest is the magnitude of weather events experienced by firms. I measure it in three ways: an indicator variable that equals one if the insurer experiences any weather event in any of the geographies it operates in; the number of weather events experienced by insurers, and lastly, the magnitude of weather events is measured in terms of economic loss caused by them. Firm fixed effects control for time-invariant firm-level characteristics. and quarter-fixed effects control for time-varying shocks. The Controls vector includes several firm-specific time-variant factors such as Size, profitability, reinsurance, geographical and business diversification. All continuous variables are winsorized at the 1% level.

The first three columns of Table 3 report regression results from estimating equation 2. The coefficients on $Disaster$ are significantly positive for all three measures of $Disaster$. It suggests a positive association between extreme weather events and abnormal losses. In general, there seems to be some evidence that weather events can cause abnormal losses to insurers.

Next, I examine whether the insurers are able to earn higher premiums in the following period. At this stage, I am not looking for the source of the increase in the premium. It could either be driven by an increase in premium rates or an increase in demand for insurance. I use the following equation to estimate how weather events impact the next period's NPE (Net Premium Earned):

$$\begin{aligned} Change_NPE_{i,t+1} = \beta_0 + \beta_1 Disaster_t \times Change_Loss_i + \beta_2 Disaster_t + \beta_3 Change_Loss_i \\ + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon \end{aligned} \quad (3)$$

In equation 3, the dependent variable $Change_NPE$ is the percentage change in NPE earned

in quarter $t+1$ compared to the same quarter in the previous year to account for seasonality. The main variable of interest is $Disaster_t \times Change_Loss_i$. Insurers tend to increase the NPE to recover losses in the previous period. I want to capture whether weather events have any additional impact on change in NPE. I use the same fixed effects and control structures as in previous tests. Columns 4-6 of Table 3 report regression results from the estimation equation 3. The coefficients on $Disaster \times Change_Loss$ are significantly positive for all measures of $Disaster$. It suggests that firms increase their NPE by a greater proportion in the period following a weather event compared to a period with no or fewer weather events. Overall, there seems to be some evidence that insurers can recoup some losses in period t by increasing the premium in period $t+1$.

Alternatively, insurers could also react to an increase in claims by increasing the percentage of premium they re-insure with an external party. Therefore, next, I look at how reinsurance trends change based on extreme weather events experience. However, insurance companies might not be able to offload a lot of risk to reinsurance, as the cost of reinsurance is also on the rise. Additionally, in some states like California, the insurers cannot pass on the cost of reinsurance to the consumers because of prohibitive regulations. Therefore, this limits the ability of the insurers to mitigate risk. I use the following equation to estimate how weather events impact Reinsurance:

$$Reinsurance_\%_{i,t} = \beta_0 + \beta_1 Disaster_t + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon \quad (4)$$

In equation 4, the dependent variable $Reinsurance_\%$ is the percentage of DPW reinsured to a third party in quarter t. The main variable of interest $Disaster$ is defined as before. Fixed effects and control structures are the same as previous specifications.

Columns 7-9 of Table 3 report regression results from estimating equation 4. The coefficient on $Disaster$ is significant at the 1% level when the disaster measure is the number of weather events. It suggests that firms increase their reinsurance level when the number of weather events increases. However, the coefficients are insignificant for the remaining two measures of $Disaster$. Overall, I do not see a consistent impact of weather events on the percentage of

DPW reinsured.

7 Market reaction

One of the major users of the disclosure are the shareholders. If shareholders do not react to these disclosures, then insurers might not have any reason to change their behavior. I start by testing investor reactions in case of extreme weather events. The Efficient Market Hypothesis suggests that if shareholders do not perceive that weather events pose any risk to insurance companies, they will not react accordingly.

I first test investor reaction to weather events. Following the event study methodology, I look at the 7-day CAR (Cumulative Abnormal Return) surrounding the weather event. I estimate the Fama-French three-factor model to measure abnormal returns. I estimate the model using 100 trading days of return data ending 50 days before the weather event. Daily abnormal stock returns are cumulated to obtain the CAR from day *t-3* before the weather event date to date *t+3*. I dropped the events that were 10 days within any earning or dividend announcement period. I computed the Average cross-sectional CAR for insurers having more than 1% and 5% of DPW in states hit by weather events. Panel A (B) of figure 6 shows the Average CAR for insurers having more than 1% (5%) DPW in affected states. The results suggest that there is no significant abnormal market response to weather events.

I, also try to capture the investor reaction after controlling for firm fundamentals and market-level controls. I use the following equation to estimate the abnormal return earned by the insurer:

$$7 - day\ CAR_{i,t} = \beta_0 + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon \quad (5)$$

In equation 5, the dependent variable $7 - day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. I control for firm-level fundamentals that could impact market response to the weather event including the abnormal loss experienced by the in-

surer ($Change_Loss$), change in premium earned in the next period (NPE_{t+1}), $Size$ (natural log of net total assets), profitability ($ROAA$), percentage of DPW insured ($Reinsurance_\%$), geographical diversification, segment diversification, policyholder surplus and percentage of exposed DPW ($Exposed_DPW$). I also control for market-level parameters that could impact abnormal returns: $Momentum$ and $Market_beta$. Lastly, I control for the magnitude of the disaster using the natural log of the economic loss caused by the disaster ($Ln_disaster_magnitude$). Following Huynh and Xia (2021), I add firm, year, and month-level fixed effects to control unobserved heterogeneity across stocks and seasonality effects. All continuous variables are winsorized at the 1% level. Detailed descriptions of the variables can be found in appendix A. Column 1 of Panel A of Table 4 reports the regression results from the estimation of equation 5. The constant term is statistically indifferent from zero. It suggests that there is no significant abnormal market response to weather events.

Next, I try to examine whether the investor response to weather events differs for firms with climate risk disclosure or not. If it is true that shareholders do not see any threat from weather events, then the presence of disclosure should not matter. I use the following equation to estimate how disclosures impact investor response:

$$7 - day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon \quad (6)$$

In equation 6, the dependent variable $7 - day\ CAR$ is the cumulative abnormal return of 7 days surrounding the weather event. The main variable of interest $Survey_Metric$ captures the insurer's response to the survey. $Response_per$ measures the percentage of questions out of nine that the insurer has responded to "Yes". A Yes indicates that the insurer accepts that climate risk poses some level of threat to the business and that the firm is taking actions to mitigate it. I also look at the responses to each individual question to test whether any particular question influences the reaction of the investors.

Columns 2-3 in Panel A of Table 4 report regression results of the estimation equation 6 for companies that responded to the survey from 2012 to 2020. The coefficient in $Response_per$ is

statistically insignificant, suggesting that the survey responses have no impact on the response of the investors to the survey. The coefficient on $Q1_d$ is significantly positive, indicating that firms that answer 'Yes' to Q1 receive a positive investor reaction. Q1 relates to whether the company has a plan to mitigate or assess its carbon emissions. The coefficients on $Q3_d$ and $Q6_d$ are significantly negative, indicating that firms that answer 'Yes' to either of these questions receive a negative investor reaction. Both of these questions relate to whether a company has a plan to assess and mitigate risk from climate change. Additionally, the coefficient on $Q8_d$[14] is significantly positive.

I also try to examine whether the investors react differently to firms that fill out the survey, irrespective of their responses. I use the following equation to estimate how disclosures impact investor response:

$$7 - day\ CAR_{i,t} = \beta_0 + \beta_1 Post_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon \quad (7)$$

In equation 7, the dependent variable $7 - day\ CAR$ is the cumulative abnormal return of 7 days surrounding the weather event. $Post$ is an indicator variable taking the value one if the year is 2012 or higher and zero otherwise. I used survey data from 2012 since I only have machine-readable data after 2012. Therefore, I skip the years 2009, 2010, and 2011 from my analysis. $Treat$ is a dummy variable that equals 1 if the firm has filled out the survey every year since 2012 and 0 if the firm has never filled the survey. All fixed effect and control variables are the same as in the previous market test specification. Panel B of Table 4 reports regression results from estimating equation 7. The coefficient on $Post \times Treat$ is statistically insignificant, suggesting investor response to weather events is indifferent between disclosing and non-disclosing firms.

Firms that are mandated to disclose climate risk could be inherently different from non-disclosing firms. To ensure that these differences do not drive my non-results, I use the entropy balancing approach. After ensuring that the control and treatment samples are balanced, I

[14] Q8 refers to whether the company employs computer modeling to manage climate risk.

examine the treated and non-treated firms in the post-period. I use the following equation to estimate how disclosures impact investor response:

$$7 - day\ CAR_{i,t} = \beta_0 + \beta_1 Disaster_mag_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon \quad (8)$$

In equation 8, the dependent variable $7 - day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. $Treat$ is a dummy variable that equals 1 if the firm has filled out the survey every year since 2012 and 0 if the firm has never filled out the survey. All fixed effect and control variables are the same as in the previous market test specification. Panel C of Table 4 reports regression results from estimating equation 8. The coefficient on $Treat \times Disaster_mag$ is statistically insignificant, suggesting that the investor response to weather events is indifferent between disclosing and non-disclosing firms.

To ensure that non-results are not driven by statistical design, I employ several robustness tests. I performed the same set of tests for companies with greater exposure than 5% (Table 5). Instead of using quarter-level controls, I repeated the analysis using the annual level of controls (Table 6). Sometimes, the news about upcoming extreme weather events is released before the event actually strikes. Therefore, I repeat the analysis for the sub-sample of tropical storms (including hurricanes) by using the event date as the date when the storm was first detected by the weather authorities (Table 7). Lastly, in recent years, large public PE firms have invested in insurance companies. I retest my market analysis by removing such public PE firms from the sample and keeping only core public insurance companies (Table 8).

Overall, I do not find any evidence of abnormal market reaction to weather events. Additionally, I am unable to find any evidence that there is a difference in investor reaction between disclosing and non-disclosing firms. Investors might not react if they do not believe climate risk to be a threat to insurers. An alternate reason for no reaction could be investor inattention. These survey disclosures are not part of financial statements, nor are they available on insurers' websites. Therefore, it might be possible that investors do not refer to them when making decisions. At this stage, I am unable to pinpoint the reason for the lack of reaction.

8 Conclusion

This study examined the impact of mandatory climate risk disclosure on insurance companies. The study is unable to find any significant impact of climate risk disclosure on P&C insurers' behavior. Collective evidence suggests that the implications of climate risk disclosure are nuanced. Despite the absence of conclusive evidence rejecting the null hypothesis that disclosure lacks influence on insurer behavior, this study attempts to uncover potential explanations for this lack of impact. It seems that insurance companies, well versed in risk management strategies, may already possess tools to navigate weather-related events, irrespective of disclosure. Moreover, shareholder reactions may play a pivotal role. The lack of shareholder response to weather events, as well as climate risk disclosures, could also lead to insurers' lack of incentive to adapt their behavior.

Finally, while the precise impact of climate risk disclosure on insurers' behavior remains complex, this study makes a significant contribution to the ongoing dialogue surrounding climate risk management in the insurance sector. By acknowledging the multifaceted interactions between regulatory changes, investor reactions, and access to disclosure information, stakeholders can better navigate the evolving landscape of climate risks and reinforce the industry's capacity to weather storms of change.

In conclusion, while climate risk disclosure has the potential to drive significant changes in insurer behavior, there are situations in which the impact might be limited. Factors such as well-established risk management practices, industry-wide risk awareness, investment strategies, compliance-driven approaches, and the long-term nature of climate risks can all contribute to scenarios where disclosure might not lead to substantial changes in behavior. It is important to consider these nuances as we explore the multifaceted relationship between disclosure and insurer behavior in the context of climate risk.

Appendix

A Variable Definition

Panel A: Reserve Deficiency Related Variables

Variable	*Description*	*Source*
Reserve Deficiency_homeowners	(Value of Homeowner's Loss incurred for periods upto year t in year t)- (Value of Homeowner's Loss incurred for periods upto year t in year t+5)	SNL
Reserve Deficiency_Total	(Value of Total Loss incurred for periods upto year t in year t)- (Value of Total Loss incurred for periods upto year t in year t+5)	SNL
Homeowner Reserve Deficiency Ratio	Reserve Deficiency_homeowners / Value of Homeowner's Loss incurred for periods upto year t in year t	SNL
Homeowner Reserve Deficiency by DPE	Reserve Deficiency_Total / Direct Premium earned from homeowner's line of business in year t	SNL
Total Reserve Deficiency Ratio	Reserve Deficiency_Total / Value of Total Loss incurred for periods upto year t in year t	SNL
Total Reserve Deficiency by DPE	Reserve Deficiency_Total / Direct Premium earned in year t	SNL

Panel B: Other Dependent Variables

Variable	*Description*	*Source*
Reinsurance_%	Percentage of DPW reinsured	SNL
Percentage of DPW earned from California	Direct premium written in California / Total direct premium written	SNL
Loss to DPW ratio in California	Loss incurred in California / Direct premium written in California	SNL

Panel C: Treatment and Post-Related Variables

Variable	*Description*	*Source*
Post	Indicator equal to one if the period is after 2012	NAIC
Treat	Indicator equal to one if the firm is required to fill the survey	NAIC

Panel D: Survey-related Variables

Variable	*Description*	*Source*
Response_per	Percentage of questions for which the insurers have responded "Yes"	NAIC
Qj_d	Indicator variable equal to one if the insurer has responded "Yes" to question j	NAIC

Panel E: Weather Events related Variables

Variable	*Description*	*Source*
Disaster Occurance	Indicator equals one if the insurer has operations in a state that has experienced a weather event	NOAA
Disaster_mag	Natural log of economic loss magnitude in USD million (CPI adjusted)	NOAA
# Disasters	Number of weather events experienced by insurer in the states it is operating	NOAA
Disaster Exposure	Percentage of DPW the insurer earns from the state impacted by at least one weather event	SNL , NOAA

Panel F: Firm Level Measures

Variable	*Description*	*Source*
DPW	Direct Written Premium	SNL
NPE	Net Premium Earned	SNL
DPE_Total	Direct Premium Earned at firm level	SNL
DPE_Homeowners	Direct Premium Earned from Homeowners' line of business	SNL
Change_NPE	$(NPE_q - NPE_{q-4})/NPE_{q-4}$	SNL
Change_Loss	(Loss incurred$_q$ − Loss incurred$_{q-4}$) / Loss incurred$_{q-4}$	SNL
Size	Natural log of net total assets	SNL
Ln_ph_surplus	Natural log of policyholder surplus	SNL
Ln_num_lines	Natural log of the number of business lines the insurer operates in	SNL
Ln_num_geo	Natural log of the number of states the insurer operates in	SNL
Roaa	Return on Average Assets	SNL
Cal_rbc_ratio	Total Adjusted capital / (2*minimum Risk-based Capital Ratio required)	SNL
Ln_npe	Natural log of NPE	SNL
Ln_loss_inc	Natural log of total loss incurred	SNL

Panel G: Additional variables in Market Response Analysis

Variable	*Description*	*Source*
Momentum	12-month stock return one month prior to the event date	CRSP
Market_beta	Market beta of the stock from the market model estimated using one year of daily stock return prior to event date. Value weighted return of all public stock in US is uased as a proxy for market return	CRSP

.

B Climate-related risks to insurance companies

Risk Category	Definition	Examples
Physical Risk	Risk arising from increased damage and losses from physical phenomena associated with both climate trends and events.	Damages caused by climate change leading to higher-than-usual claim payouts and losses in asset values
Transition Risk	Risk arising from disruptions and shifts associated with the transition to a low-carbon economy.	Changing consumer preferences, market forces, business practices, or public policies leading to declining market demand for carbon-intensive industries could impact the investment side of the balance sheet
Liability Risk	Risk arising from climate-related claims under liability policies, and direct litigation against insurers for failing to manage climate risks	Litigation related to climate risk could increase claim payout for liability insurance policies
Operational Risk	Risk to physical damage to insurer's assets	Damage to physical property of insurers could negatively impact their ability to carry out their operations
Reputational Risk	Risk to insurer's reputation due to climate change related issues	Insurers could attract negative publicity for underwriting and/or investing in fossil fuel companies

Source: Issues Paper on Climate Change Risks to the Insurance Sector [15]

[15] https://www.insurancejournal.com

C Timeline of Survey Adoption

Year	Participating States	Premium Requirements
2010	CA	$500 Mn in DPW
2011	CA	$300 Mn in DPW
2012	CA, NY, WA	$300 Mn in DPW
2013	CA, NY, WA, CT, MN, NM	$100 Mn in DPW
2021-present	CA, NY, WA, CT, MN, NM, DE, DC, ME, MD, MA, OR, PA, RI, VT	$100 Mn in DPW

State Codes: CA: California, CT: Connecticut, DC: District of Columbia, DE: Delaware, ME: Maine, MD: Maryland, MA: Massachusetts, MN: Minnesota, NM: New Mexico, NY: New York, OR:Oregon, PA: Pennsylvania, RI: Rhode island, VT: Vermont, WA: Washington

D Survey Questions - Original

1. Does the company have a plan to assess, reduce or mitigate its emissions in its operations or organizations?
2. Does the company have a climate change policy with respect to risk management and, investment management?
3. Describe your company's process for identifying climate change-related risks and assessing the degree that they could affect your business, including financial implications.
4. Summarize the current or anticipated risks that climate change poses to your company. Explain the ways that these risks could affect your business. Include identification of the geographical areas affected by these risks.
5. (a) Has the company considered the impact of climate change on its investment portfolio?
   (b) Has it altered its investment strategy in response to these considerations?
6. Summarize steps the company has taken to encourage policyholders to reduce the losses caused by climate change-influenced events.
7. Discuss steps, if any, the company has taken to engage key constituencies on the topic of climate change.
8. Describe actions the company is taking to manage the risks climate change poses to your business including, in general terms, the use of computer modeling.

E Disclosure Samples

Following are sample of survey responses from 2019 survey

Summarize the current or anticipated risks that climate change poses to your company. Explain the ways that these risks could affect your business. Include identification of the geographical areas affected by these risks.

Y

Climate change, to the extent it produces changes in weather patterns, could affect the frequency or severity of weather events and wildfires. As a property and casualty insurer, we may face significant losses from catastrophes. There is generally an increase in the frequency and severity of auto and property claims when severe weather occurs. We consider the greatest areas of potential catastrophe losses due to hurricanes generally to be major metropolitan centers in counties along the eastern and gulf coasts of the United States.

Property catastrophe exposure management includes purchasing reinsurance to provide coverage for known exposure to hurricanes, earthquakes, wildfires, fires following earthquakes and other catastrophes. To the extent climate change results in more frequent catastrophic weather events, the cost of reinsurance is likely to rise.

The financial implications related to severe weather events can vary. Our current reinsurance program continues to support our risk tolerance framework that targets less than a 1 percent likelihood of annual aggregate catastrophe losses from hurricanes and earthquakes, net of reinsurance, exceeding $2 billion, based on modelled assumptions and applications currently available.

To the extent that climate change impacts valuation of commercial real estate properties or municipalities in which we invest, our investment results would be impacted. Allstate's investments throughout the United States could be affected by risks associated with other physical climate drivers.

AllState Insurance Co.

Summarize the current or anticipated risks that climate change poses to your company. Explain the ways that these risks could affect your business. Include identification of the geographical areas affected by these risks.

N

As our CEO, Evan Greenberg, stated in his 2018 letter to shareholders, "Climate change is a reality and its effects can be seen by an increased frequency and severity of natural catastrophes. Climate change is contributing to higher sea surface temperatures, rising sea levels and an increasing trend in extreme weather events, including floods, droughts, winter storms, heat waves, wildfires and hurricane intensity. These weather events are colliding with the realities of urbanization — the growing exposures from the concentration of people and values created by the long-term shift from rural to urban living, including suburban sprawl — and so many located near water and wilderness because that's where people want to live. Add to that government social policies that insulate people and society from the true costs of their decisions. Hurricanes Florence, Michael and Harvey were significant events causing record flooding in the U.S. Meanwhile, 2018 was the deadliest and most destructive wildfire season on record in California following '17's record-setting wildfires. Given the long-term threat and the short-term nature of politics, the failure of policymakers to address climate change, including these issues and the costs of living in or near high-risk areas, is an existential threat. As an underwriting company, our job is to understand, structure and assume climate change-related risk for a fair price, and only do so to the extent of our balance sheet wherewithal and our ability to spread the risk to third-party capital. Our approach to underwriting is fact-based and relies on both our own experience and scientific expertise, and that of the expert network we engage outside our organization. Climate risk is complex and requires a deep and evolving understanding of the physical processes causing weather extremes. These tools are improving and are providing better insights to aid in how we think about these perils, but much remains unknown. For example, what were traditionally non-modeled risks can now be better analyzed, but flood models, for instance, are more advanced than those for wildfire, which remain relatively crude. We also recognize that no matter how good, there is still much basis risk in our conclusions. However, keep in mind that natural catastrophes are a short-tail risk, so losses are understood relatively quickly, and we can in most cases react to what we observe."

Chubb Corp.

F Survey Questions - TCFD aligned

Governance

Disclose the insurer's governance around climate-related risks and opportunities, including the following:

- Identify and include any publicly stated goals on climate-related risks and opportunities.
- Describe where climate-related disclosure is handled within the insurer's structure, e.g., at a group level, entity level, or a combination. If handled at the group level, describe what activities are undertaken at the company level.
- Describe the board and/or committee responsible for the oversight of climate-related risks and opportunities.
- Describe management's role in assessing and managing climate-related risks and opportunities.

Strategy

Disclose the actual and potential impacts of climate-related risks and opportunities on the insurer's businesses, strategy, and financial planning where such information is material. Insurers should consider including the following:

- Describe the steps the insurer has taken to engage key constituencies on the topic of climate risk and resiliency.
- Describe the insurer's plan to assess, reduce, or mitigate its greenhouse gas emissions in its operations or organizations.
  - Describe the climate-related risks and opportunities the insurer has identified over the short, medium, and long term.
  - Describe the impact of climate-related risks and opportunities on the insurer's business, strategy, and financial planning.
  - Describe the resilience of the insurer's strategy, taking into consideration different climate-related scenarios, including a 2 degree Celsius or lower scenario.

Risk Management

Disclose how the insurer identifies, assesses, and manages climate-related risks, including the following:

- Describe how the insurer considers the impact of climate related risks on its underwriting portfolio, and how the company is managing its underwriting exposure with respect to physical, transition and liability risk.
- Describe any steps the insurer has taken to encourage policyholders to manage their potential physical and transition climate related risks, if applicable.
- Describe how the insurer has considered the impact of climate-related risks on its investment portfolio, including what investment classes have been considered.
  - Describe the insurers' processes for identifying and assessing climate-related risks.
  - Describe the insurer's processes for managing climate-related risks.
  - Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the insurer's overall risk management.
- Discuss whether climate-related risks are addressed through the insurer's general enterprise-risk management process or a separate process and how frequently the process is completed.
- Discuss the climate scenarios utilized by the insurer to analyze its underwriting risks, including which risk factors the scenarios consider, what types of scenarios are used, and what time frames are considered.
- Discuss the climate scenarios utilized by the insurer to analyze risks on its investments, including which risk factors are utilized, what types of scenarios are used, and what time frames are considered.

Metrics and Targets

Disclose the metrics and targets used to assess and manage relevant collateralized risks and opportunities where such information is material. Insurers should consider including the following:

- Discuss how the insurer uses catastrophe modeling to manage the climate related risks to your business. Please specify for which climate-related risks the insurer uses catastrophe models to assess, if any.
- Disclose the metrics used by the insurer to assess climate-related risks and opportunities in line with its strategy and risk management process.
- Disclose Scope 1, Scope 2, and if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
- Describe the targets used by the insurer to manage climate-related risks and opportunities and performance against targets.

G Reserve Deficiency

Following is the Schedule P - part 2 from The Progressive Insurance Group's 2022 statutory filings. The 6^{th} column shows that in 2017 Progressive estimated $71.569 billion of losses incurred for claims related to 2017 and previous years. This estimate was revised downward to $71.4 billion by 2022. The difference between the revised estimate of cumulative losses and the original cumulative losses estimated is defined as the "Reserve Deficiency". Thus, the 2017 reserve deficiency for progressive is $168.271 million.

COMBINED STATEMENT FOR THE YEAR 2022 OF THE Progressive Insurance Group

SCHEDULE P - PART 2 - SUMMARY

Years in Which Losses Were Incurred	INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										DEVELOPMENT	
	1 2013	2 2014	3 2015	4 2016	5 2017	6 2018	7 2019	8 2020	9 2021	10 2022	11 One Year	12 Two Year
1. Prior	3,142,701	3,079,170	3,013,783	2,933,970	2,960,690	2,972,271	2,985,970	2,996,385	3,000,078	3,007,943	7,865	11,558
2. 2013	11,393,888	11,346,720	11,302,570	11,340,888	11,254,945	11,262,790	11,274,916	11,276,209	11,280,899	11,283,482	2,583	7,273
3. 2014	XXX	12,308,270	12,076,671	12,098,043	12,132,201	12,062,482	12,083,746	12,090,796	12,089,326	12,086,803	(2,523)	(3,994)
4. 2015	XXX	XXX	13,154,148	13,110,989	13,141,575	13,182,995	13,110,644	13,129,847	13,135,275	13,135,535	259	5,688
5. 2016	XXX	XXX	XXX	15,155,788	15,147,257	15,224,570	15,281,657	15,201,496	15,247,431	15,251,742	4,311	50,246
6. 2017	XXX	XXX	XXX	XXX	16,763,458	16,752,261	16,827,904	16,854,670	16,781,868	16,803,892	22,024	(50,778)
7. 2018	XXX	XXX	XXX	XXX	XXX	19,449,104	19,569,220	19,657,049	19,744,447	19,646,225	(98,223)	(10,824)
8. 2019	XXX	XXX	XXX	XXX	XXX	XXX	22,710,124	22,741,160	22,873,780	22,959,438	85,658	218,278
9. 2020	XXX	XXX	XXX	XXX	XXX	XXX	XXX	22,228,646	22,197,902	22,221,602	23,700	(7,044)
10. 2021	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	30,177,921	30,307,247	129,326	XXX
11. 2022	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	34,338,923	XXX	XXX
12. Totals											174,980	220,403

References

Beatty, Anne, Lin Cheng, and Haiwen Zhang, 2019, Are risk factor disclosures still relevant? evidence from market reactions to risk factor disclosures before and after the financial crisis, *Contemporary Accounting Research* 36, 805–838.

Christensen, Hans B., Eric Floyd, Lisa Yao Liu, and Mark Maffett, 2017, The real effects of mandated information on social responsibility in financial reports: Evidence from mine-safety records, *Journal of Accounting and Economics* 64, 284–304.

Deloitte, 2019, Climate risk: Regulators sharpen their focus, Technical report.

FIO, (Federal Insurance Office), 2023, Insurance supervision and regulation of climate-related risks, Report, U.S. Department of the Treasury.

Gaver, Jennifer J., and Jeffrey S. Paterson, 2004, Do insurers manipulate loss reserves to mask solvency problems?, *Journal of Accounting and Economics* 37, 393–416.

Grace, Martin F., and J. Tyler Leverty, 2012, Property-liability insurer reserve error: Motive, manipulation, or mistake, *Journal of Risk and Insurance* 79, 351–380.

Griffin, Paul A, David H Lont, and Estelle Y Sun, 2017, The relevance to investors of green-house gas emission disclosures, *Contemporary Accounting Research* 34, 1265–1297.

Hagendorff, Bjoern, Jens Hagendorff, and Kevin Keasey, 2015, The impact of mega-catastrophes on insurers: An exposure-based analysis of the U.S. homeowners' insurance market, *Risk Analysis* 35, 157–173.

Hail, Luzi, Maximilian Muhn, and David Oesch, 2021, Do risk disclosures matter when it counts? evidence from the swiss franc shock, *Journal of Accounting Research* 59, 283–330.

Hope, Ole Kristian, Danqi Hu, and Hai Lu, 2016, The benefits of specific risk-factor disclosures, *Review of Accounting Studies* 21, 1005–1045.

Huynh, Thanh D, and Ying Xia, 2021, Panic selling when disaster strikes: Evidence in the bond and stock markets, *Management Science* .

IAIS, (International Association of Insurance Supervisors), 2023, ICP 20 public disclosures.

III, (Insurance Information Institute), 2023.

Ivantsova, Anastasia, Kyeonghee Kim, and Joyce Xiao Lin, 2021, Climate risk disclosure and institutional investors: Evidence from the insurance industry, *Available at SSRN 3984467* .

Jr., Roger Pielke, 2023, "Billion Dollar Disasters" are a national embarrassment.

Kanodia, Chandra, and Haresh Sapra, 2016, A real effects perspective to accounting measurement and disclosure: Implications and insights for future research, *Journal of Accounting Research* 54, 623–676.

Kim, Jeong Bon, Chong Wang, and Feng Wu, 2022, The real effects of risk disclosures: evidence from climate change reporting in 10-ks, *Review of Accounting Studies* .

Lamb, Reinhold P, 1995, An exposure-based analysis of property-liability insurer stock values around hurricane andrew.

Leuz, Christian, and Peter D Wysocki, 2016, The economics of disclosure and financial reporting regulation: Evidence and suggestions for future research, *Journal of Accounting Research* 54, 525–622.

Mahrt-Ganley, Nicole, 2023, U.S. P & C insurers facing hardest market in a generation: New white paper examines mounting inflation, claims, reinsurance and other capital costs, White paper, American Property Casulty Insurance Association.

Matsumura, Ella Mae, Rachna Prakash, and Sandra C Vera-Munoz, 2014, Firm-value effects of carbon emissions and carbon disclosures, *The Accounting Review* 89, 695–724.

NCEI, (National Centers for Environmental Information), 2023, Billion-dollar weather and climate disasters.

Oh, Sangmin S, Ishita Sen, and Ana-Maria Tenekedjieva, 2002, Pricing of climate risk insurance: Regulation and cross-subsidies, *Available at SSRN 3762235* .

Petroni, Kathy Ruby, 1992, Optimistic reporting in the property-casualty insurance industry, *Journal of Accounting and Economics* 15, 485–508.

Roychowdhury, Sugata, Nemit Shroff, and Rodrigo S. Verdi, 2019, The effects of financial reporting and disclosure on corporate investment: A review, *Journal of Accounting and Economics* 68.

Schuh, Frederick, and Tanja Jaeckle, 2022, Impact of hurricanes on US insurance stocks, *Risk Management and Insurance Review* .

SEC, 2023, Comments for the enhancement and standardization of climate-related disclosures for investors.

She, Guoman, 2022, The real effects of mandatory nonfinancial disclosure: Evidence from supply chain transparency, *The Accounting Review* 97, 399–425.

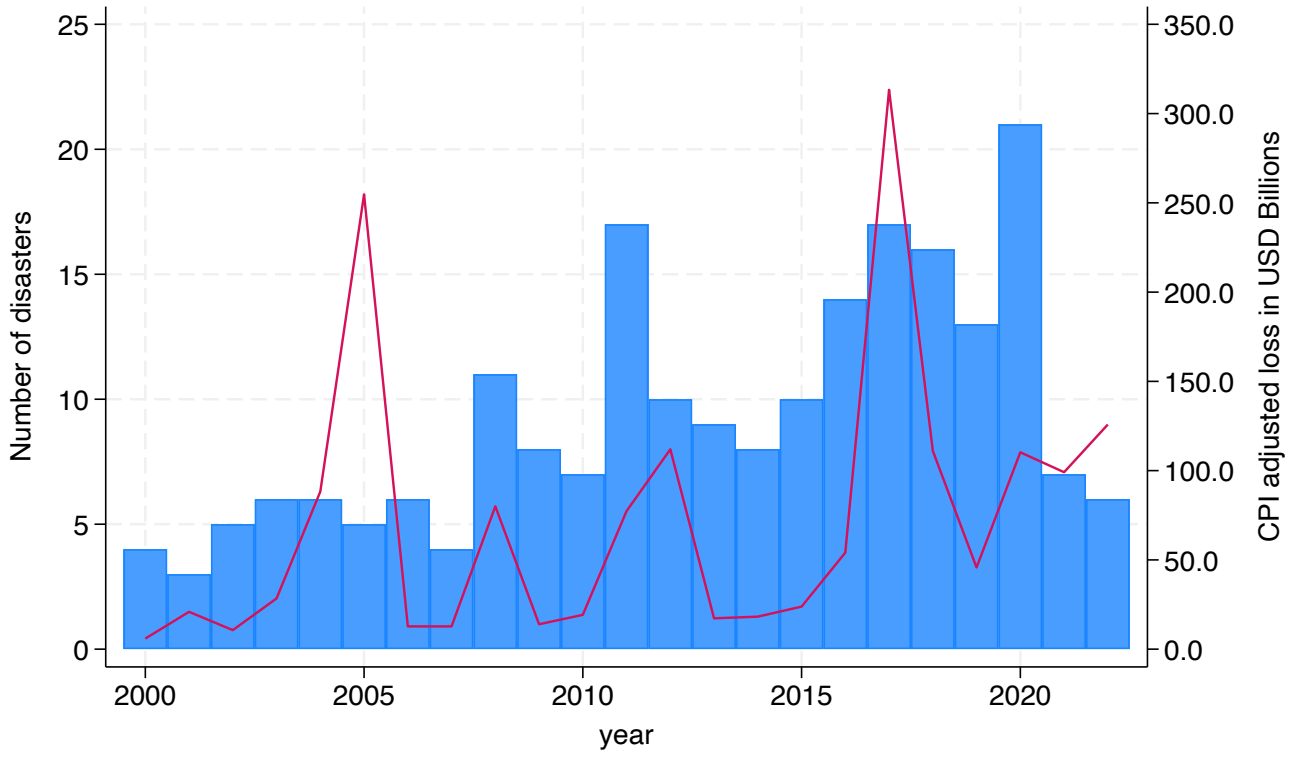
Shelor, Roger M, Dwight C Anderson, and Mark L Cross, 1992, Gaining from loss: Property-liability insurer stock values in the aftermath of the 1989 california earthquake, *The Journal of Risk and Insurance* 59, 476–488.

Smith, Ian, 2023, Insurers rack up $50bn in losses from natural catastrophes this year.

Tomar, Sorabh, 2023, Greenhouse gas disclosure and emissions benchmarking, *Journal of Accounting Research* .

Figure 1: Extreme Weather Events

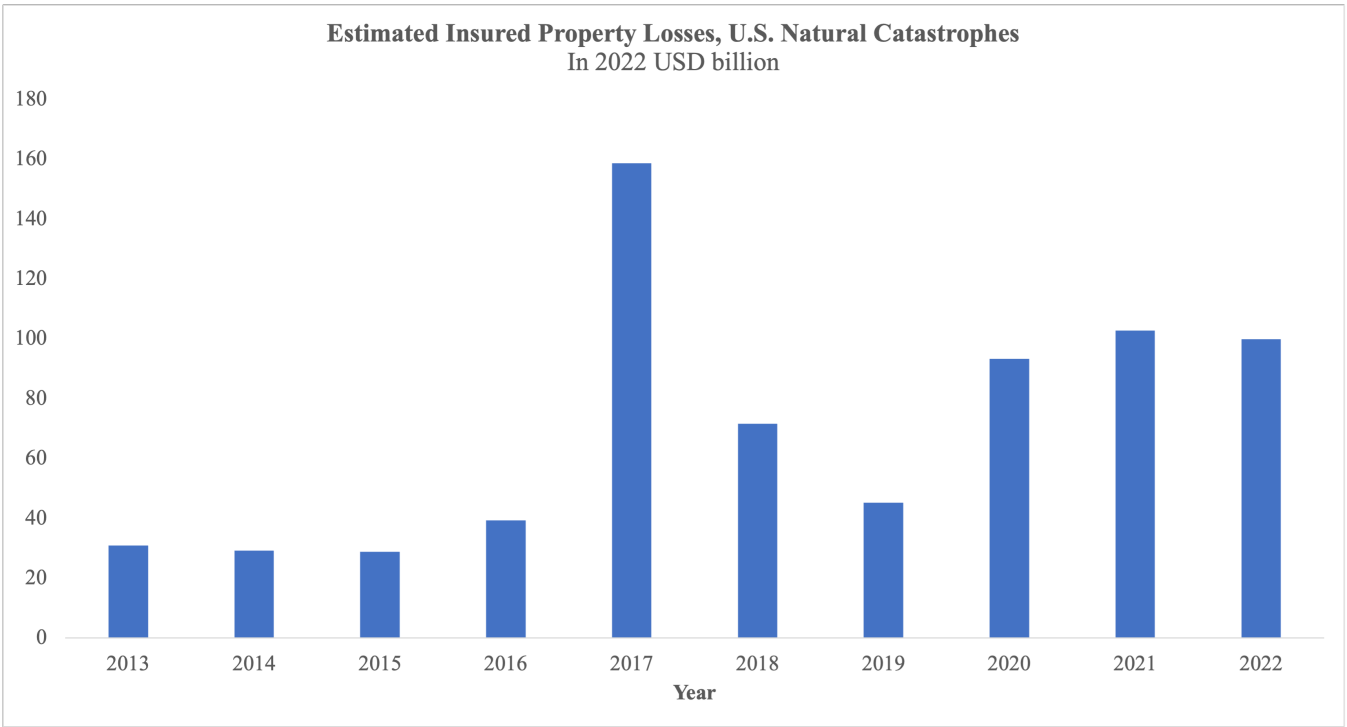
This figure shows the Number of Extreme Weather Events (Events causing economic Loss ¿ $1Billion)



Source: NCEI (National Center for Environmental Information)

Figure 2: Extreme Weather Events

This figure shows the estimated insured property losses



Source: Insurance Information Institute

Figure 3: Climate Risk Disclosure - Trends in Survey Responses

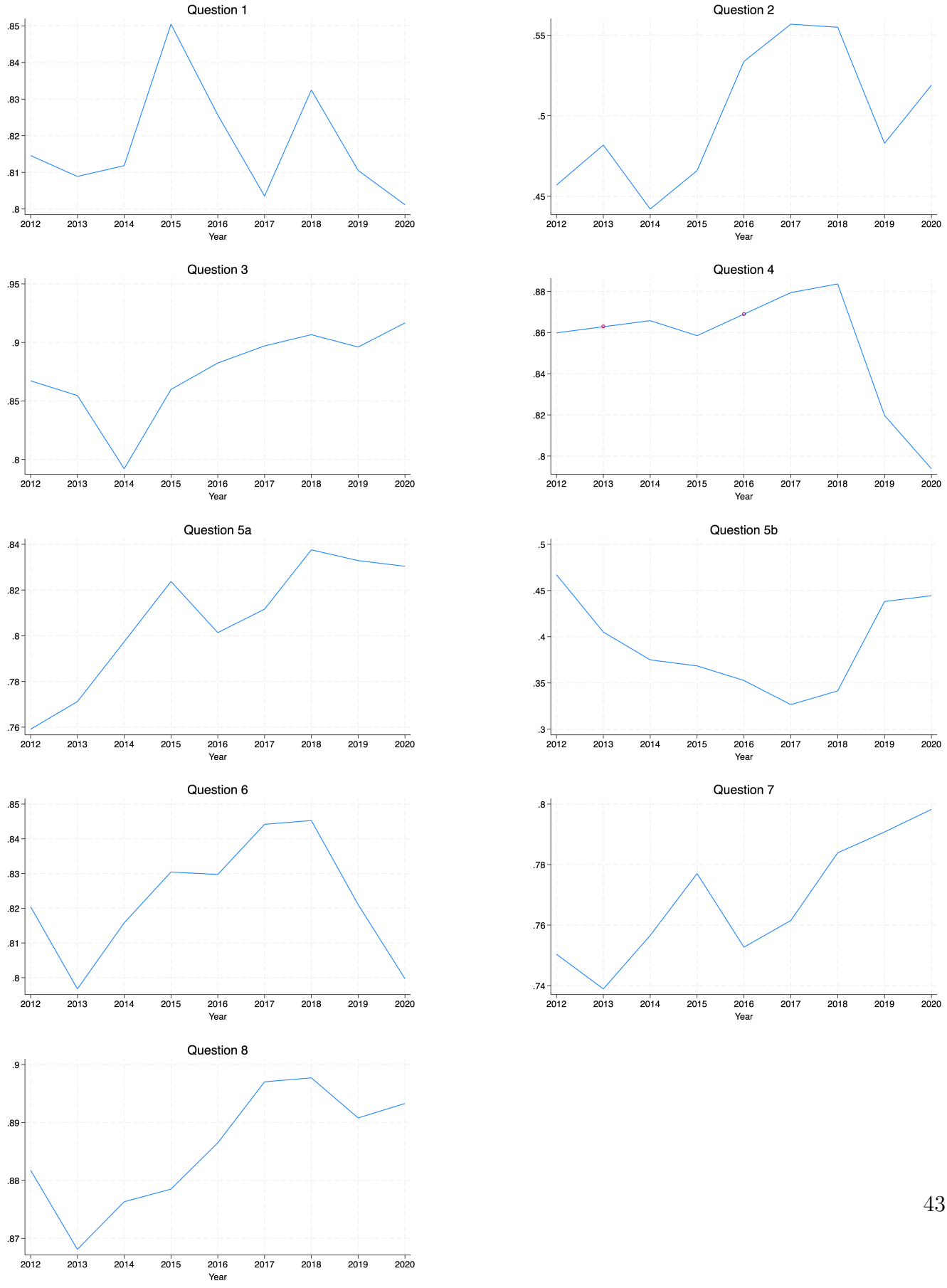


Figure 4: Compliance

This figure shows the proportion of insurers responding to the survey at the threshold in 2013

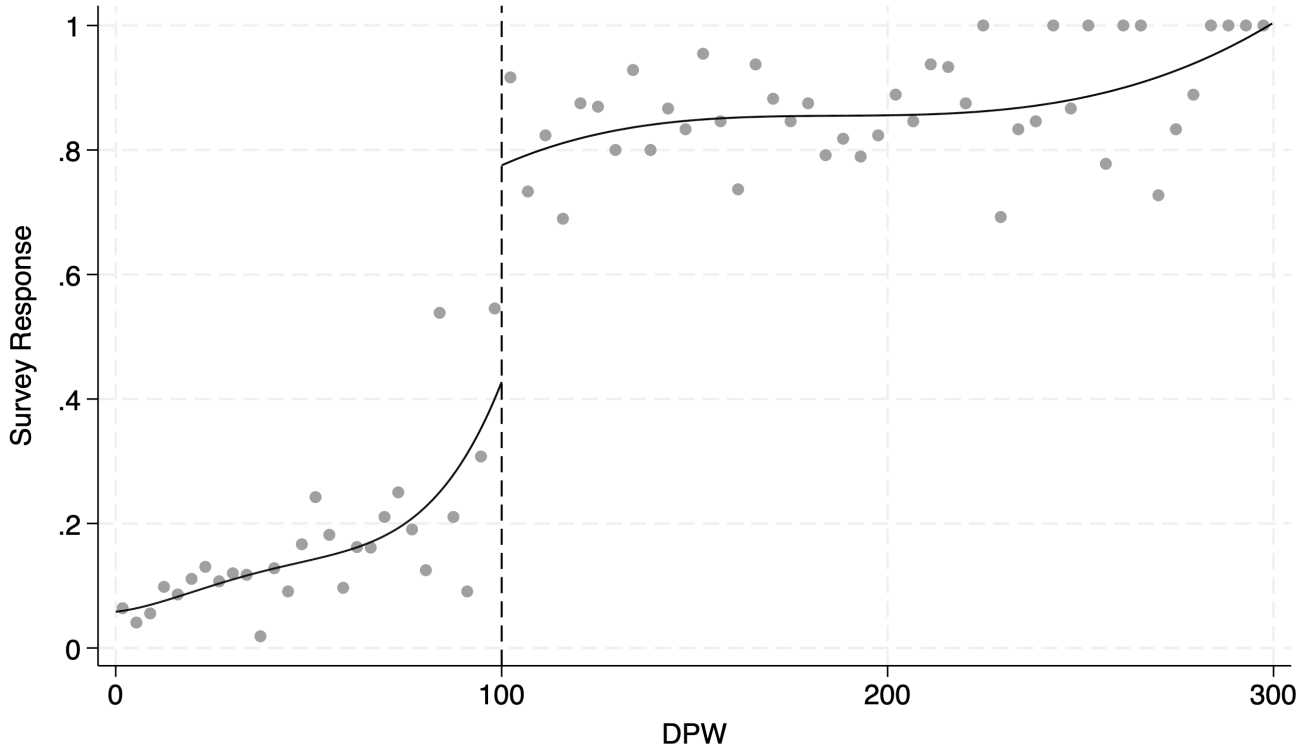


Figure 5: Continuity

This figure plots the manipulation testing plot at the threshold

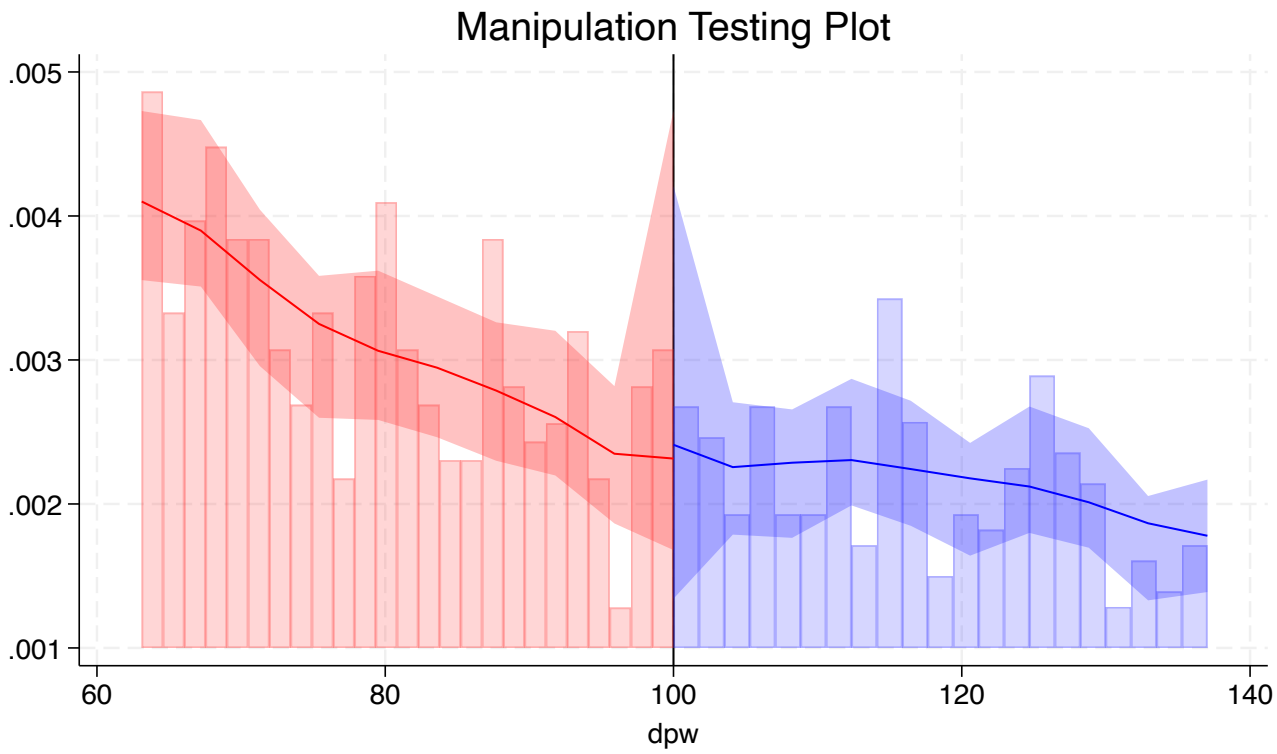
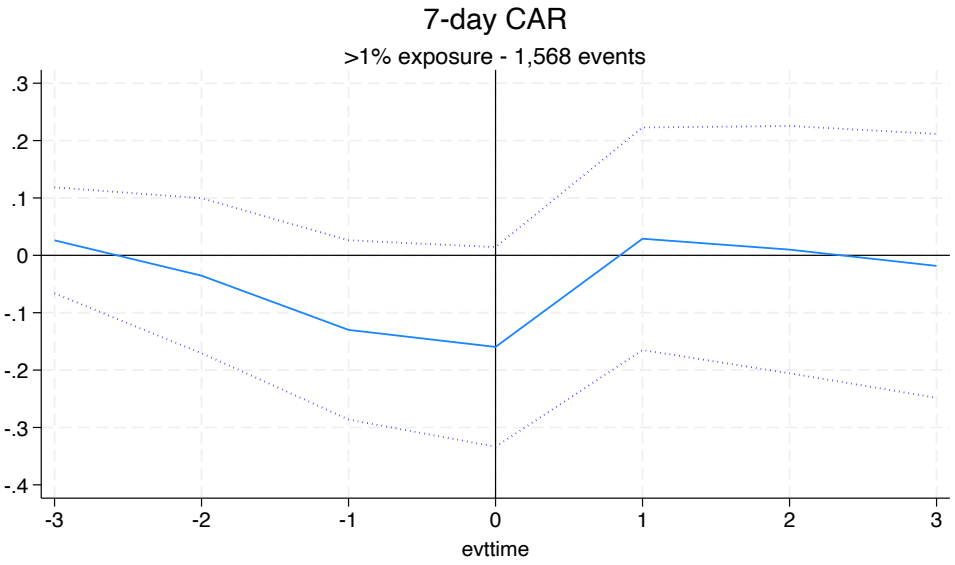


Figure 6: 7-day CAR surrounding the weather event

This figure shows the 7-day CAR Surrounding the weather event. Panel A shows the 7-day CAR for Insurers with greater than 1% of DPW in affected states. Panel B shows the 7-day CAR for Insurers with greater than 5% of DPW in affected states. I estimate the Fama-French three-factor model to measure abnormal returns. I estimate the model using 100 trading days of return data ending 50 days before the weather event. Daily abnormal stock returns are cumulated to obtain the CAR from day *t-3* before the weather event date to day *t+3*. I drop the vents that were 10 days within any earning or dividend announcement period. I computed the Average cross-sectional CAR for insurers having more than 1% and 5% of DPW in states hit by weather events.

Panel A: Insurers with 1% of DPW in affected states



Panel B: Insurers with 5% of DPW in affected states

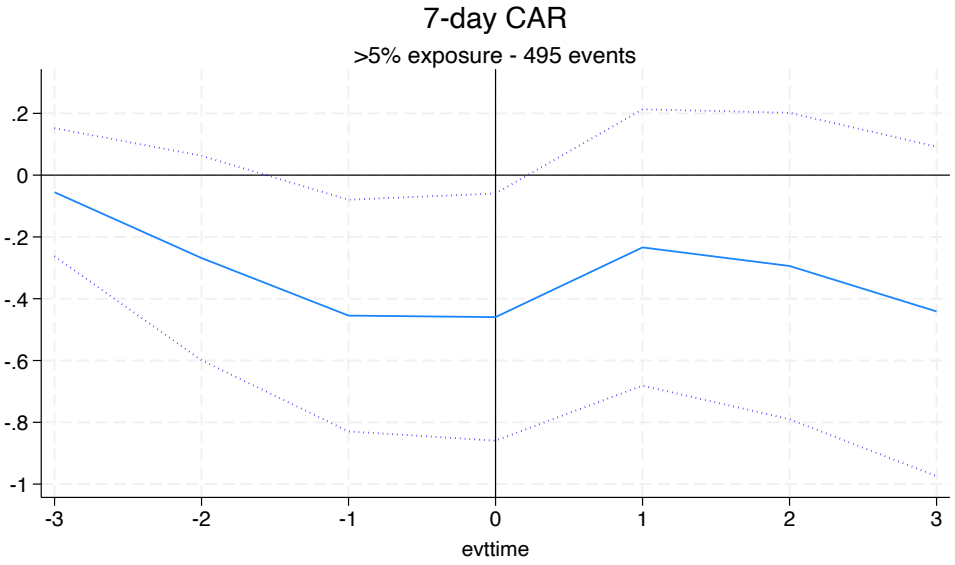


Table 1: Descriptive Statistics

This table presents descriptive statistics for the key variables used in the main analyses. Panel A presents the mean, standard deviation, and distributional statistics of the treatment and control group in the pre-period (2009-2012). Panel B presents the statistics for the post-period (2013-2017). All variable definitions appear in Appendix A.

Panel A: Pre-period

	Control (n=120)			*Treat(n=212)*			*Diff in Mean*
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	Control - Treat
Total Reserve Deficiency Ratio	-0.029	0.079	-0.014	-0.011	0.077	-0.015	-0.019**
Total Reserve Deficiency by DPE	-0.076	0.154	-0.047	-0.049	0.151	-0.029	-0.027
Homeowner Reserve Deficiency Ratio	-0.043	0.163	-0.017	-0.019	0.144	-0.011	-0.023
Homeowner Reserve Deficiency by DPE	-0.068	3.114	-0.056	-0.046	0.489	-0.023	-0.022
Reinsurance_%	1.151	1.757	1.000	1.172	1.594	1.000	-0.021
Percentage of DPW earned from California	0.632	0.871	0.150	0.373	0.564	0.159	0.258***
Loss to DPW ratio in california	-0.104	5.375	0.348	3.005	15.357	0.381	-3.109**
Reserve Deficiency_homeowners (USD Mn)	-0.919	2.266	-0.360	-0.828	2.117	-0.185	-0.092
Reserve Deficiency_Total (USD Mn)	-16.763	62.691	-1.935	-19.136	68.862	-4.621	2.373
DPE_Homeowners (USD Mn)	13.445	17.081	5.837	34.332	43.956	16.854	-20.886***
DPE_Total (USD Mn)	109.231	200.739	53.427	363.347	791.652	157.870	-254.117***
Number of States	30.100	19.100	39.000	42.208	14.646	50.000	-12.108***
Number of Business Lines	9.267	3.899	8.500	12.722	4.857	13.000	-3.455***
Ln_ph_surplus	4.057	1.117	3.876	5.055	1.300	4.858	-0.998***
Size	4.809	1.184	4.698	6.025	1.258	5.890	-1.216***
Net Total Assets (USD Mn)	284.258	542.334	109.749	2201.043	10678.253	361.361	-1916.785***
Roaa	2.093	4.774	2.534	2.324	3.140	2.330	-0.231

Panel B: Post-period

	Control (n=120)			*Treat(n=212)*			*Diff in Mean*
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	Control - Treat
Total Reserve Deficiency Ratio	-0.003	0.104	-0.012	-0.003	0.096	-0.014	0.000
Total Reserve Deficiency by DPE	-0.022	0.203	-0.033	-0.039	0.145	-0.038	0.017
Homeowner Reserve Deficiency Ratio	-0.003	0.128	-0.004	-0.047	0.220	-0.007	0.044**
Homeowner Reserve Deficiency by DPE	0.968	4.251	-0.009	-0.058	0.691	-0.011	1.026***
Reinsurance_%	1.171	2.302	0.859	1.097	1.748	1.000	0.074
Percentage of DPW earned from California	0.457	0.707	0.136	0.315	0.475	0.169	0.142**
Loss to DPW ratio in california	0.766	11.744	0.428	1.063	7.788	0.463	-0.297
Reserve Deficiency_homeowners (USD Mn)	-0.246	1.307	-0.036	-0.674	2.684	-0.047	0.428**
Reserve Deficiency_Total (USD Mn)	-6.799	32.047	-1.243	-13.229	71.259	-4.061	6.430
DPE_Homeowners (USD Mn)	15.466	17.547	9.262	36.236	51.880	13.792	-20.770***
DPE_Total (USD Mn)	109.037	229.341	59.496	513.301	1155.131	190.471	-404.264***
Number of States	32.257	18.553	39.000	43.925	14.470	51.000	-11.668***
Number of Business Lines	8.850	4.184	7.500	12.403	4.780	13.000	-3.553***
Ln_ph_surplus	4.098	0.982	4.114	5.303	1.361	4.927	-1.205***
Size	4.851	1.043	4.809	6.272	1.261	6.006	-1.421***
Net Total Assets (USD Mn)	259.404	535.921	122.629	2658.474	11112.141	405.996	-2399.070***
Roaa	1.273	4.619	1.627	2.244	3.712	2.241	-0.970**

Table 2: Impact of Climate Risk Disclosure

Panel A, B, and C presents regression results from estimating the equation: $Firm_Financials_{i,t} = \beta_0 + \beta_1 Treat_i \times Post_t \times Disater_t + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + \epsilon$. *Treat* is an indicator variable that equals one if \$100 Mn <= insurer's DPW < \$300 Mn and zero if the insurer's DPW < \$100 Mn. *Post* is an indicator variable that equals one if the time period is greater or equal to 2013. Disaster is one of the three variables capturing the impact of weather events on insurers: Number of weather events experienced by insurers, the magnitude of weather events (in terms of economic loss caused by them), or percentage of DPW exposed to these weather events. The independent variables are size, profitability, reinsurance, geographical and business diversification. In panel A, the dependent variable *Firm_Financials* is reserve deficit. In panel B, the dependent variable is the percentage of DPW reinsured. Finally, in panel C the dependent variable is the insurer's business in California. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Panel A: Impact on Reserve Deficiency

	# Homeowner Reserve Deficiency Ratio			*Homeowner Reserve Deficiency by DPE*			*Total Reserve Deficiency Ratio*			*Total Reserve Deficiency by DPE*		
Dependent Variable	*Disaster_mag*	*# Disasters*	*Disaster Exposure*	*Disaster_mag*	*# Disasters*	*Disaster Exposure*	*Disaster_mag*	*# Disasters*	*Disaster Exposure*	*Disaster_mag*	*# Disasters*	*Disaster Exposure*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Treat×Post×Disaster	-0.008	-0.001	0.087*	-0.069	-0.098	-0.156	0.019	0.002	0.016	0.005	0.000	0.222
	(-0.41)	(-0.12)	(1.71)	(-0.18)	(-1.19)	(-0.13)	(1.50)	(0.87)	(0.37)	(0.07)	(0.01)	(1.02)
Treat×Post	0.047	-0.040	-0.082**	-0.704	-0.559	-0.894	-0.221	-0.029	-0.027	-0.059	-0.056	-0.214
	(0.22)	(-0.80)	(-2.30)	(-0.18)	(-0.61)	(-1.08)	(-1.61)	(-0.86)	(-0.89)	(-0.08)	(-0.23)	(-1.25)
Post×Disaster	0.025	0.002	-0.044	0.612	0.153**	0.953	-0.014	-0.002	-0.028	-0.018	-0.007	-0.349
	(1.08)	(0.71)	(-1.02)	(1.54)	(2.03)	(0.82)	(-1.05)	(-0.94)	(-0.92)	(-0.19)	(-0.50)	(-1.46)
Treat×Disaster	0.012	0.002	-0.044	0.257*	0.112	-0.374	-0.008	-0.004*	-0.041	0.060	-0.001	-0.197
	(1.12)	(0.98)	(-1.48)	(1.70)	(1.46)	(-0.98)	(-0.98)	(-1.85)	(-1.40)	(1.34)	(-0.15)	(-0.80)
Disaster	-0.011	-0.002	0.037	-0.281*	-0.115	0.249	0.011	0.002	0.042**	0.018	0.007	0.456
	(-1.01)	(-0.89)	(1.30)	(-1.89)	(-1.50)	(0.83)	(1.04)	(1.01)	(2.22)	(0.30)	(0.34)	(1.44)
Size	0.005	-0.008	-0.009	-1.858*	-1.627*	-1.601	-0.093**	-0.081*	-0.081*	-0.084	-0.148	-0.139
	(0.07)	(-0.11)	(-0.13)	(-1.87)	(-1.66)	(-1.65)	(-2.14)	(-1.95)	(-1.93)	(-0.39)	(-0.58)	(-0.56)
Ln_num_geo	0.066	0.052	0.045	0.865	1.925	1.191	0.033	0.049	0.052	0.053	0.060	0.093
	(1.10)	(0.77)	(0.64)	(0.85)	(1.40)	(0.82)	(0.80)	(1.26)	(1.35)	(0.52)	(0.68)	(1.00)
Ln_num_lines	0.120*	0.119**	0.118*	-0.879	-1.171	-1.304	0.042	0.024	0.025	0.172	0.158	0.167
	(1.98)	(2.00)	(1.97)	(-0.73)	(-1.02)	(-1.08)	(1.06)	(0.62)	(0.67)	(0.94)	(0.58)	(0.58)
Ln_ph_surplus	0.054	0.051	0.053	-0.016	0.037	0.006	0.016	0.014	0.014	-0.061	-0.244	-0.251
	(1.26)	(1.09)	(1.23)	(-0.02)	(0.04)	(0.01)	(0.48)	(0.43)	(0.42)	(-0.29)	(-0.82)	(-0.83)
Rein_ceded	0.008	0.009	0.009	-0.516	-0.473	-0.462	0.016**	0.019**	0.018**	0.036	0.139**	0.139**
	(0.58)	(0.62)	(0.65)	(-1.62)	(-1.50)	(-1.44)	(2.01)	(2.44)	(2.42)	(0.75)	(2.09)	(2.15)
Roaa	-0.003	-0.001	-0.000	-0.015	0.016	0.028	0.003	0.002	0.002	-0.003	-0.001	-0.001
	(-1.65)	(-0.33)	(-0.14)	(-0.37)	(0.45)	(0.79)	(1.21)	(1.12)	(1.16)	(-0.34)	(-0.10)	(-0.06)
Constant	-0.944**	-0.702*	-0.665*	10.086	7.147	9.798	0.123	0.040	0.017	-0.484	0.585	0.367
	(-2.33)	(-1.93)	(-1.92)	(1.54)	(1.13)	(1.38)	(0.53)	(0.21)	(0.09)	(-0.34)	(0.54)	(0.38)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.538	0.525	0.525	0.115	0.115	0.103	0.610	0.609	0.609	0.589	0.661	0.662
N	725	792	792	732	799	799	2448	2651	2651	2463	2666	2666

Table 2: Impact of Climate Risk Disclosure (Cont.)

Panel B: Impact on Reinsurance

Dependent variable	Reinsurance %		
	Disaster_mag	# Disasters	Disaster exposure
	(1)	(2)	(3)
Treat×Post×Disaster	0.040	-0.006	0.272*
	(1.02)	(-0.77)	(1.81)
Treat×Post	-0.436	0.059	-0.143
	(-1.01)	(0.57)	(-1.22)
Post×Disaster	0.051	0.009	-0.093
	(1.54)	(1.63)	(-0.67)
Treat×Disaster	-0.026	0.002	-0.063
	(-0.96)	(0.29)	(-0.57)
Disaster	0.026	0.002	0.066
	(0.55)	(0.16)	(0.84)
Size	-0.006	-0.027	-0.019
	(-0.05)	(-0.24)	(-0.16)
Ln_num_geo	-0.070	-0.052	-0.055
	(-1.42)	(-1.04)	(-1.09)
Ln_num_lines	0.243**	0.143	0.148
	(2.35)	(1.48)	(1.53)
Ln_ph_surplus	-0.007	0.045	0.047
	(-0.06)	(0.40)	(0.41)
Roaa	0.002	0.001	0.001
	(0.70)	(0.63)	(0.63)
Constant	0.175	0.513	0.547
	(0.22)	(0.88)	(0.92)
Year F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.664	0.643	0.643
N	3368	3668	3668

Table 2: Impact of Climate Risk Disclosure (Cont.)

Panel C: Impact on Business in California

	Percentage of DPW earned from California			*Loss to DPW ratio in California*		
Dependent Variable	*Disaster_mag*	*# Disasters*	*Disaster Exposure*	*Disaster_mag*	*# Disasters*	*Disaster Exposure*
	(1)	(2)	(3)	(4)	(5)	(6)
Treat ×Post× Disaster	0.005	-0.001	0.016	0.114	-0.003	0.020
	(0.45)	(-0.49)	(0.37)	(0.30)	(-0.04)	(0.01)
Treat×Post	-0.048	0.026	0.008	-1.540	-0.114	0.003
	(-0.38)	(0.58)	(0.23)	(-0.37)	(-0.09)	(0.00)
Post×Disaster	0.000	0.002	-0.015	-0.089	0.010	-2.431*
	(0.00)	(0.77)	(-0.38)	(-0.24)	(0.16)	(-1.74)
Treat×Disaster	0.000	0.002	0.025	0.633**	0.065	2.296
	(0.02)	(0.94)	(1.07)	(2.04)	(1.03)	(1.36)
Disaster	-0.012	-0.002	-0.041*	0.002	-0.039	0.161
	(-1.17)	(-0.85)	(-1.67)	(0.01)	(-0.49)	(0.14)
Size	0.010	0.042	0.043	0.352	1.075	1.141
	(0.25)	(0.94)	(0.97)	(0.21)	(0.68)	(0.73)
Ln_num_geo	-0.079	-0.061	-0.064	-0.088	0.254	0.274
	(-1.30)	(-1.10)	(-1.16)	(-0.11)	(0.37)	(0.39)
Ln_num_lines	-0.034	-0.057	-0.059	3.990*	4.338**	4.219**
	(-1.02)	(-1.57)	(-1.60)	(1.79)	(2.08)	(2.00)
Ln_ph_surplus	0.018	0.023	0.024	-0.379	-0.376	-0.398
	(0.78)	(0.99)	(1.05)	(-0.32)	(-0.34)	(-0.36)
Rein_ceded	0.000	0.005	0.004	-0.153	-0.082	-0.114
	(0.04)	(0.48)	(0.41)	(-0.28)	(-0.17)	(-0.23)
Cal_rbc_ratio	-0.000	0.000	0.000	0.000	0.000	0.000
	(-0.27)	(0.02)	(0.04)	(1.60)	(1.25)	(1.34)
Roaa	-0.000	0.000	0.000	-0.029	-0.016	-0.017
	(-0.11)	(0.29)	(0.17)	(-0.79)	(-0.46)	(-0.48)
Ln_dpw_cal				0.676	0.528	0.519
				(0.95)	(0.76)	(0.75)
Constant	0.604**	0.412*	0.440**	-11.069*	-10.278**	-10.239**
	(2.55)	(1.87)	(2.03)	(-1.75)	(-1.98)	(-1.97)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.918	0.935	0.936	0.096	0.126	0.129
N	2979	3220	3220	2327	2503	2503

Table 3: Impact of extreme weather events on the quarterly financials of insurance companies

Panel A presents regression results from estimating the equation: $Change_Loss_{i,t} = \beta_0 + \beta_1 Disaster_t + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon$ Panel B presents regression results from estimating the equation: $Change_NPE_{i,t+1} = \beta_0 + \beta_1 Disater_t \times Change_Loss_i + \beta_2 Disaster_t + \beta_3 Change_Loss_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon$ Panel C presents regression results from estimating the equation: $Reinsurance_\%_{i,t} = \beta_0 + \beta_1 Disaster_t + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Quarter\ FE + \epsilon$ *Change_Loss* is percentage change in loss incurred in quarter t compared to quarter $t-4$. *Change_NPE* is the percentage change in NPE earned in quarter $t+1$ compared to the same quarter in the previous year. *Reinsurance_%* is the percentage of DPW reinsured to a third party. Disaster is one of the three variables capturing the impact of weather events on insurers: Indicator variable that takes the value 1 if the insurer experienced a weather event in the quarter t, the number of weather events experienced by the insurers, or the magnitude of the weather events (in terms of the economic loss caused by them). The independent variables are size, profitability, reinsurance, geographical, and business diversification. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

	Change_Loss			*Impact on Future NPE*			*Reinsurance %*		
Dependent Variable	*Disaster Occurrence*	*# Disasters*	*Disaster_mag*	*Disaster Occurrence*	*# Disasters*	*Disaster_mag*	*Disaster Occurrence*	*# Disasters*	*Disaster_mag*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Disaster × change_loss				0.082***	0.064***	0.010***			
				(4.53)	(3.58)	(4.58)			
Disaster	0.108***	0.078**	0.014***	-0.018	-0.009	-0.002	0.008	0.017***	0.001
	(3.11)	(2.49)	(3.27)	(-1.52)	(-0.89)	(-1.51)	(1.13)	(2.79)	(1.57)
Change_loss				0.057***	0.059***	0.057***			
				(13.63)	(14.03)	(13.64)			
Reinsurance_%	-0.077**	-0.078**	-0.078**	-0.075***	-0.075***	-0.075***			
	(-2.40)	(-2.41)	(-2.41)	(-5.66)	(-5.67)	(-5.66)			
Size	-0.265***	-0.265***	-0.266***	0.054**	0.053**	0.054**	0.052***	0.052***	0.052***
	(-3.12)	(-3.12)	(-3.13)	(2.05)	(2.01)	(2.04)	(3.36)	(3.32)	(3.35)
ln_ph_surplus	-0.104*	-0.103*	-0.103*	-0.076***	-0.075***	-0.076***	-0.014	-0.014	-0.014
	(-1.80)	(-1.78)	(-1.79)	(-3.79)	(-3.72)	(-3.78)	(-1.33)	(-1.29)	(-1.32)
Ln_num_lines	-0.490***	-0.486***	-0.491***	-0.056	-0.055	-0.056	0.216***	0.215***	0.216***
	(-3.89)	(-3.86)	(-3.90)	(-1.19)	(-1.16)	(-1.18)	(10.69)	(10.67)	(10.68)
Ln_num_geo	-0.074	-0.074	-0.074	-0.048**	-0.048**	-0.048**	0.028**	0.028**	0.028**
	(-1.40)	(-1.39)	(-1.40)	(-2.28)	(-2.31)	(-2.29)	(2.22)	(2.22)	(2.22)
Roaa	-0.033***	-0.033***	-0.033***	0.000	-0.000	0.000	0.001	0.001	0.001
	(-9.97)	(-9.96)	(-9.95)	(0.09)	(-0.01)	(0.10)	(1.08)	(1.12)	(1.09)
Cal_rbc_ratio	-0.000	-0.000	-0.000	-0.000***	-0.000***	-0.000***	-0.000	-0.000	-0.000
	(-0.45)	(-0.44)	(-0.45)	(-5.25)	(-5.24)	(-5.26)	(-1.49)	(-1.50)	(-1.50)
Disasater_Exposure	-0.274	-0.274	-0.277	-0.033	-0.037	-0.034	0.134***	0.132***	0.133***
	(-1.30)	(-1.30)	(-1.32)	(-0.35)	(-0.39)	(-0.37)	(3.08)	(3.03)	(3.06)
Ln_npe	0.286***	0.286***	0.286***				-0.048***	-0.048***	-0.048***
	(7.20)	(7.19)	(7.19)				(-4.49)	(-4.48)	(-4.49)
Ln_loss_inc							0.008	0.008	0.008
							(1.56)	(1.50)	(1.54)
Constant	3.107***	3.092***	3.110***	0.587***	0.583***	0.588***	-0.152	-0.150	-0.151
	(5.25)	(5.22)	(5.25)	(2.84)	(2.81)	(2.84)	(-1.44)	(-1.42)	(-1.43)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.063	0.063	0.063	0.152	0.150	0.152	0.494	0.494	0.494
N	48995	48995	48995	48225	48225	48225	49770	49770	49770

Table 4: Market reaction

Panel A presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. Panel B presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Post_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. Panel C presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Disaster_mag_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. $7-day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. *Response_per* measures the percentage of questions out of nine to which the insurer has responded Yes. *Post* is an indicator variable one if year is $\geq$ 2012, and zero otherwise. $Treat$ is a dummy variable that equals one if the firm has filled the survey in every year since 2012, and zero if the firm has never filled the survey. The independent variables are Size, profitability, reinsurance, geographical and business diversification, momentum, and market beta. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Table 4: Market reaction (Cont.)

Panel A: Market reaction to insurance company stocks on occurrence of extreme weather event

	7-day CAR		
Dependent Variable	*Financials*	*Survey Response*	*Survey Response*
	(1)	(2)	(3)
Response_per		0.006	
		(0.51)	
Q1_d			0.026**
			(2.05)
Q2_d			0.005
			(1.31)
Q3_d			-0.026*
			(-1.90)
Q4_d			0.012
			(1.17)
Q*5a_d*			0.013
			(1.23)
Q*5b_d*			-0.003
			(-0.71)
Q6_d			-0.096***
			(-3.85)
Q7_d			0.004
			(0.49)
Q8_d			0.113***
			(3.11)
$Change_npe_{t+1}$	0.003	0.011	-0.006
	(0.41)	(0.58)	(-0.28)
Change_loss	0.005	0.027***	0.020*
	(1.27)	(2.64)	(1.93)
Disaster_mag	-0.004***	-0.007***	-0.007***
	(-2.68)	(-3.87)	(-3.72)
Market_beta	0.397	0.039	-0.038
	(0.76)	(0.05)	(-0.05)
Momentum	-0.026***	-0.026***	-0.029***
	(-4.58)	(-3.22)	(-3.42)
Reinsurance_%	0.008**	0.031***	0.026**
	(2.16)	(3.07)	(2.49)
Size	0.015	-0.002	0.031
	(1.03)	(-0.07)	(0.88)
Ln_ph_surplus	-0.007	0.006	-0.018
	(-0.57)	(0.23)	(-0.71)
Ln_num_lob	0.026*	0.016	0.009
	(1.69)	(0.68)	(0.36)
Ln_num_states	-0.006	-0.082***	-0.185***
	(-0.37)	(-2.82)	(-4.84)
Roaa	0.000	0.001	0.000
	(0.71)	(0.80)	(0.21)
Exposed_DPW	0.000	0.059	0.046
	(0.03)	(1.44)	(1.51)
Constant	-0.146	0.246	0.447
	(-1.41)	(0.82)	(1.63)
Year F.E.	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.105	0.131	0.139
N	1462	591	591

Table 4: Market reaction (Cont.)

Panel B: Market response to extreme events for disclosing vs non-disclosing firms

	$7-day\ CAR$
Dependent Variable	*Survey Reported*
	(1)
Post×Treat	0.001
	(0.05)
$Change_npe_{t+1}$	-0.000
	(-0.04)
Change_loss	0.006
	(1.32)
Disaster_mag	-0.003*
	(-1.72)
Market_beta	0.736
	(1.16)
Momentum	-0.032***
	(-4.49)
Reinsurance_%	0.009**
	(2.22)
Size	0.021
	(1.05)
Ln_ph_surplus	-0.014
	(-0.90)
Ln_num_lob	0.039**
	(2.00)
Ln_num_states	0.002
	(0.11)
Roaa	0.000
	(0.69)
Exposed_DPW	0.005
	(0.37)
Constant	-0.215
	(-1.48)
Year F.E.	Yes
Month F.E.	Yes
Firm F.E.	Yes
Adj. R^2	0.087
N	1039

Table 4: Market reaction (Cont.)

Panel C: Market response to extreme events for disclosing vs non-disclosing firms (entropy balanced)

	$7-day\ CAR$
Dependent Variable	*Survey Reported*
	(1)
Treat×Disaster_mag	-0.001
	(-0.26)
$Change_npe_{t+1}$	0.008
	(0.41)
Change_loss	-0.004
	(-0.45)
Disaster_mag	-0.005
	(-1.50)
Market_beta	0.318
	(0.41)
Momentum	-0.023***
	(-2.59)
Reinsurance_%	0.020**
	(1.97)
Size	0.003
	(0.13)
Ln_ph_surplus	0.002
	(0.07)
Ln_num_lob	-0.005
	(-0.15)
Ln_num_states	-0.046
	(-1.08)
Roaa	-0.001
	(-1.28)
Exposed_DPW	0.032
	(0.89)
Constant	0.135
	(0.47)
Year F.E.	Yes
Month F.E.	Yes
Firm F.E.	Yes
Adj. R^2	0.208
N	1114

Table 5: Market reaction (Robustness: 5% exposure)

Table 5 presents the results for insurers with greater than 5% of exposure to extreme weather events. Panel A presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. Panel B presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Post_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. Panel C presents regression results from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Disaster_mag_t \times Treat_i + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. $7-day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. *Response_per* measures the percentage of questions out of nine to which the insurer has responded Yes. *Post* is an indicator variable one if year is $\geq$ 2012, and zero otherwise. $Treat$ is a dummy variable that equals one if the firm has filled the survey in every year since 2012, and zero if the firm has never filled the survey. The independent variables are Size, profitability, reinsurance, geographical and business diversification, momentum, and market beta. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Table 5: Market reaction (Robustness: 5% exposure) (Cont.)

Panel A: Market reaction to insurance company stocks on occurrence of extreme weather event

	7-day CAR		
Dependent Variable	*Financials*	*Survey Response*	*Survey Response*
	(1)	(2)	(3)
Response_per		-0.001	
		(-0.02)	
Q1_d			0.044*
			(1.84)
Q2_d			0.006
			(0.60)
Q3_d			0.033
			(0.27)
Q4_d			0.026
			(1.57)
Q*5a_d*			-0.055
			(-0.47)
Q*5b_d*			-0.007
			(-0.70)
Q6_d			-0.148**
			(-2.53)
Q7_d			0.015
			(1.03)
$Change_npe_{t+1}$	0.028	0.026	-0.022
	(1.57)	(0.29)	(-0.20)
Change_loss	0.001	0.045	0.033
	(0.17)	(1.52)	(1.00)
Disaster_mag	-0.008**	-0.005	-0.006
	(-2.50)	(-0.98)	(-1.08)
Market_beta	0.546	-0.365	-0.972
	(0.56)	(-0.18)	(-0.39)
Momentum	-0.033***	-0.045*	-0.049
	(-3.38)	(-1.77)	(-1.61)
Reinsurance_%	0.016***	0.083***	0.085***
	(2.64)	(3.37)	(3.25)
Size	-0.012	-0.061	0.057
	(-0.40)	(-0.55)	(0.41)
Ln_ph_surplus	0.008	0.041	-0.035
	(0.32)	(0.52)	(-0.38)
Ln_num_lob	-0.013	0.079*	0.066
	(-0.42)	(1.67)	(1.39)
Ln_num_states	-0.018	-0.082	-0.191
	(-0.95)	(-1.15)	(-1.02)
Roaa	-0.000	-0.000	-0.001
	(-0.23)	(-0.00)	(-0.39)
Exposed_DPW	0.011	0.062	0.057
	(0.64)	(1.29)	(1.62)
Constant	0.191	0.422	0.229
	(0.82)	(0.46)	(0.26)
Year F.E.	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.148	0.169	0.170
N	473	162	162

Table 5: Market reaction (Robustness: 5% exposure) (Cont.)

Panel B: Market response to extreme events for disclosing vs non-disclosing firms

	$7-day\ CAR$
Dependent Variable	*Survey Reported*
	(1)
Post×Treat	-0.005
	(-0.14)
$Change_npe_{t+1}$	0.020
	(1.00)
Change_loss	0.002
	(0.40)
Disaster_mag	-0.005
	(-1.29)
Market_beta	0.374
	(0.29)
Momentum	-0.038***
	(-3.31)
Reinsurance_%	0.016**
	(2.18)
Size	-0.025
	(-0.57)
Ln_ph_surplus	0.013
	(0.41)
Ln_num_lob	0.051
	(1.31)
Ln_num_states	-0.020
	(-0.90)
Roaa	-0.000
	(-0.12)
Exposed_DPW	0.014
	(0.73)
Constant	0.151
	(0.43)
Year F.E.	Yes
Month F.E.	Yes
Firm F.E.	Yes
Adj. R^2	0.117
N	351

Table 5: Market reaction (Robustness: 5% exposure) (Cont.)

Panel C: Market response to extreme events for disclosing vs non-disclosing firms (entropy balanced)

	$7-day\ CAR$
Dependent Variable	*Survey Reported*
	(1)
Treat×Disaster_mag	-0.003
	(-0.29)
$Change_npe_{t+1}$	0.040
	(0.89)
Change_loss	0.019
	(1.03)
Disaster_mag	-0.002
	(-0.20)
Market_beta	0.468
	(0.27)
Momentum	-0.025
	(-1.49)
Reinsurance_%	0.008
	(0.56)
Size	0.064
	(1.31)
Ln_ph_surplus	-0.057
	(-1.29)
Ln_num_lob	-0.002
	(-0.05)
Ln_num_states	-0.025
	(-0.52)
Roaa	0.002
	(1.27)
Exposed_DPW	0.095**
	(2.41)
Constant	-0.093
	(-0.16)
Year F.E.	Yes
Month F.E.	Yes
Firm F.E.	Yes
Adj. R^2	0.424
N	389

Table 6: Market reaction (Robustness: Annual level controls)

Table 6 presents the results with the annual level of firm controls. It presents regression results from the equation $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. $7-day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. *Response_per* measures the percentage of questions out of nine to which the insurer has responded Yes.The independent variables are Size, profitability, reinsurance, geographical and business diversification, momentum, and market beta. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Table 6: Market reaction (Robustness: Annual level controls) (Cont.)

	7-day CAR		
Dependent Variable	*Financials*	*Survey Response*	*Survey Response*
	(1)	(2)	(3)
Response_per		0.007	
		(0.57)	
Q1_d			0.016
			(1.26)
Q2_d			0.007*
			(1.74)
Q3_d			-0.012
			(-0.91)
Q4_d			-0.002
			(-0.15)
Q*5a_d*			0.017
			(1.47)
Q*5b_d*			-0.005
			(-1.02)
Q6_d			-0.106***
			(-4.28)
Q7_d			0.009
			(1.12)
Q8_d			0.104***
			(2.86)
Disaster_mag	-0.004**	-0.004**	-0.004**
	(-2.05)	(-2.04)	(-2.09)
Market_beta	0.561	0.493	0.329
	(0.70)	(0.61)	(0.38)
Momentum	-0.023***	-0.023***	-0.026***
	(-2.91)	(-2.92)	(-3.23)
Reinsurance_%	-0.009	-0.016	-0.003
	(-0.27)	(-0.49)	(-0.10)
Size	-0.016	-0.015	0.029
	(-0.46)	(-0.45)	(0.83)
Ln_ph_surplus	0.015	0.016	-0.017
	(0.55)	(0.59)	(-0.64)
Ln_num_lob	0.014	0.014	0.002
	(0.55)	(0.55)	(0.08)
ln_num_states	-0.071**	-0.074**	-0.180***
	(-2.18)	(-2.31)	(-4.87)
Roaa	-0.000	-0.000	-0.000
	(-0.06)	(-0.01)	(-0.33)
Exposed_DPW	0.032	0.032	0.023
	(0.85)	(0.83)	(0.94)
Constant	0.308	0.293	0.468
	(1.01)	(0.95)	(1.61)
Year F.E.	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.121	0.230	0.228
N	585	145	145

Table 7: Market reaction (Robustness: Formation date of Tropical storm)

Table 7 presents the results using formation date of tropical storms as the event date from estimating the equation $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. $7-day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. *Response_per* measures the percentage of questions out of nine to which the insurer has responded Yes.The independent variables are Size, profitability, reinsurance, geographical and business diversification, momentum, and market beta. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Table 7: Market reaction (Robustness: Formation date of Tropical storm) (Cont.)

	7-day CAR		
Dependent Variable	*Financials*	*Survey Response*	*Survey Response*
	(1)	(2)	(3)
Response_per		-0.058*	
		(-1.94)	
Q1_d			0.038
			(1.07)
Q2_d			-0.029**
			(-2.35)
Q3_d			-0.002
			(-0.06)
Q4_d			-0.040*
			(-1.98)
Q*5a_d*			-0.019
			(-0.83)
Q*5b_d*			-0.019
			(-1.34)
Q6_d			0.082*
			(1.94)
Q7_d			-0.011
			(-0.45)
Q8_d			-0.031
			(-0.58)
$Change_npe_{t+1}$	0.005	-0.064**	-0.085***
	(0.72)	(-2.32)	(-2.90)
Change_loss	-0.001	0.005	0.003
	(-0.22)	(0.39)	(0.23)
Disaster_mag	0.008***	0.011*	0.012*
	(2.64)	(1.66)	(1.69)
Market_beta	0.237	-2.255	-1.050
	(0.32)	(-1.51)	(-0.50)
Momentum	-0.023***	-0.030*	-0.016
	(-2.59)	(-1.73)	(-0.95)
Reinsurance_%	-0.005	-0.125***	-0.119***
	(-0.71)	(-3.62)	(-3.34)
Size	-0.035**	-0.133**	-0.130*
	(-1.99)	(-2.19)	(-1.83)
Ln_ph_surplus	0.030*	0.087	0.062
	(1.92)	(1.36)	(0.90)
Ln_num_lob	0.023	0.065	0.052
	(1.09)	(1.01)	(0.73)
Ln_num_states	-0.045**	-0.414	-0.254
	(-2.09)	(-1.52)	(-0.88)
Roaa	-0.001*	-0.009***	-0.006***
	(-1.66)	(-3.97)	(-2.81)
Constant	0.134	2.361**	2.032
	(0.94)	(2.02)	(1.63)
Year F.E.	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.121	0.230	0.228
N	585	145	145

Table 8: Market reaction (Robustness: Excluding public PE owned insurers)

Table 8 presents the results after excluding firms owned by public PE (private equity) companies from estimating the equation: $7-day\ CAR_{i,t} = \beta_0 + \beta_1 Survey_Metric_{i,t} + \Sigma\gamma_j Control^j_{i,t} + Firm\ FE + Year\ FE + Month\ FE + Disasater\ FE + \epsilon$. $7-day\ CAR$ is the 7-day cumulative abnormal return surrounding the weather event. *Response_per* measures the percentage of questions out of nine to which the insurer has responded Yes.The independent variables are Size, profitability, reinsurance, geographical and business diversification, momentum, and market beta. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Standard errors are clustered at the firm level. T-stats are presented in parentheses. All variable definitions appear in Appendix A.

Table 8: Market reaction (Robustness: Excluding public PE owned insurers) (Cont.)

	7-day CAR		
Dependent Variable	*Financials*	*Survey Response*	*Survey Response*
	(1)	(2)	(3)
Response_per		-0.007	
		(-0.42)	
Q1_d			-0.082
			(-1.24)
Q2_d			-0.005
			(-0.95)
Q3_d			0.014
			(0.19)
Q*5a_d*			0.008
			(0.51)
Q*5b_d*			-0.003
			(-0.43)
Q6_d			-0.012
			(-0.19)
Q7_d			-0.003
			(-0.19)
$Change_npe_{t+1}$	0.007	0.024	-0.011
	(0.65)	(0.70)	(-0.35)
Change_loss	0.001	0.030**	0.023*
	(0.14)	(2.51)	(1.92)
Disaster_mag	-0.003**	-0.007***	-0.007***
	(-2.21)	(-3.55)	(-3.53)
Market_beta	1.089*	1.359	1.373
	(1.86)	(1.55)	(1.38)
Momentum	-0.024***	-0.009	-0.013
	(-3.67)	(-1.04)	(-1.38)
Reinsurance_%	0.006	0.034*	0.031*
	(1.03)	(1.94)	(1.70)
Size	0.005	-0.050	-0.028
	(0.27)	(-1.41)	(-0.73)
Ln_ph_surplus	-0.006	-0.004	-0.022
	(-0.43)	(-0.17)	(-0.85)
Ln_num_lob	0.018	0.015	0.011
	(1.13)	(0.57)	(0.40)
Ln_num_states	-0.005	-0.026	-0.014
	(-0.34)	(-0.75)	(-0.16)
Roaa	0.000	0.002	0.002
	(0.72)	(1.55)	(1.34)
Exposed_DPW	0.003	0.025	0.022
	(0.21)	(0.56)	(0.71)
Constant	-0.001	0.964***	0.915**
	(-0.01)	(3.07)	(2.47)
Year F.E.	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes
Adj. R^2	0.121	0.192	0.209
N	1123	438	438